S/147/60/000/02/012/020
E031/E413

On the Turbulent Flow of a Fluid

are 4 figures.

SUBMITTED: December 29, 1959

Card 2/2

VB

L 27453-66 EWT(1)/EWA(h)

ACC NR: AP5027033 SOURCE CODE: UR/0120/65/000/005/0198/0201

AUTHOR: Polyakova, G. N.; Popov, A. I.; Fogel', Ya. M. 34

ORG: Physics-Engineering Institute, AN UkrSSR, Khar'kov (Fiziko-tekhnicheskiy institut AN UkrSSR) B

TITLE: Characteristics of photomultipliers 25 for weak light flux measurements

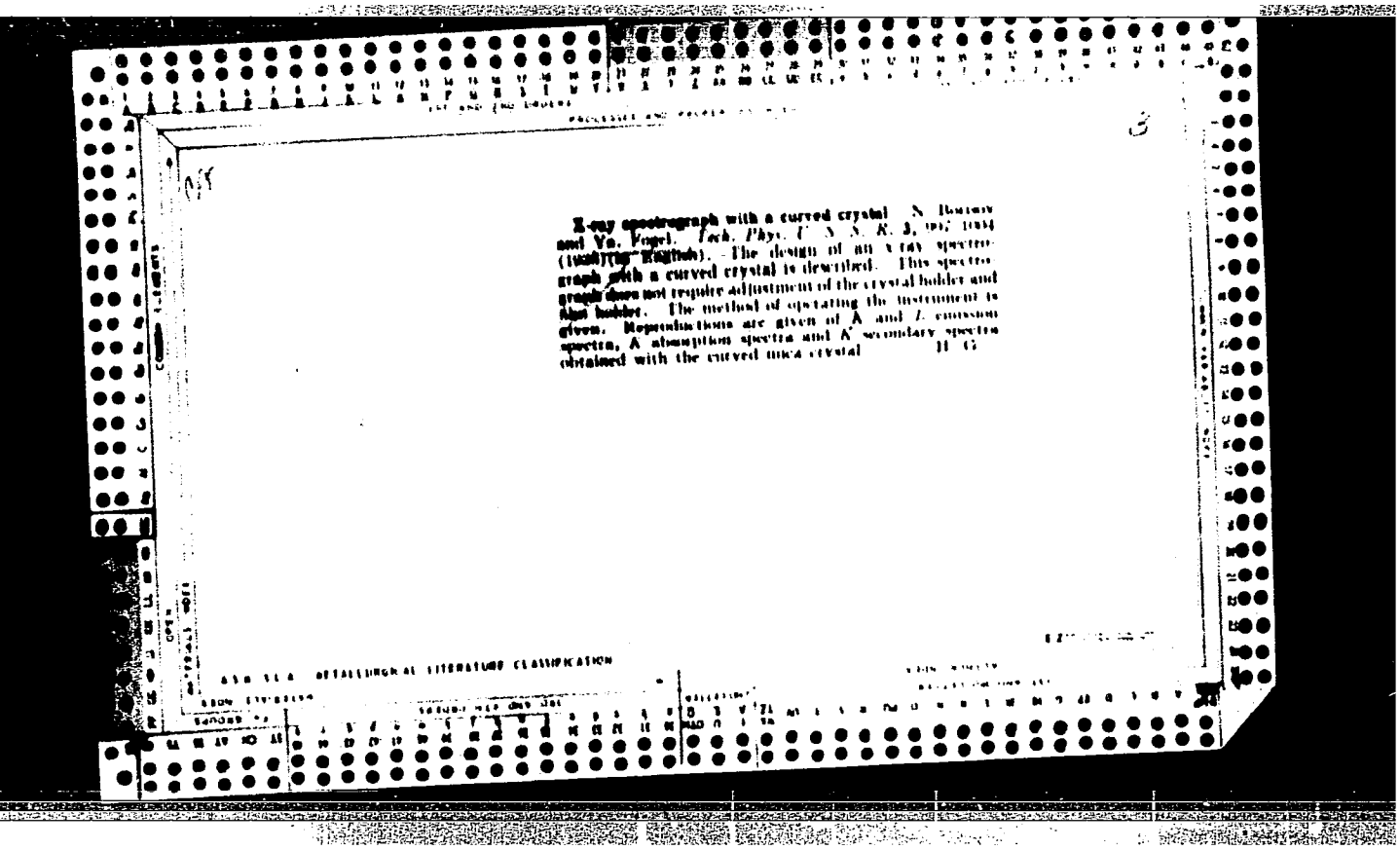
SOURCE: Pribory i tekhnika eksperimenta, no. 5, 1965, 198-201

TOPIC TAGS: photomultiplier, temperature dependence, visible light

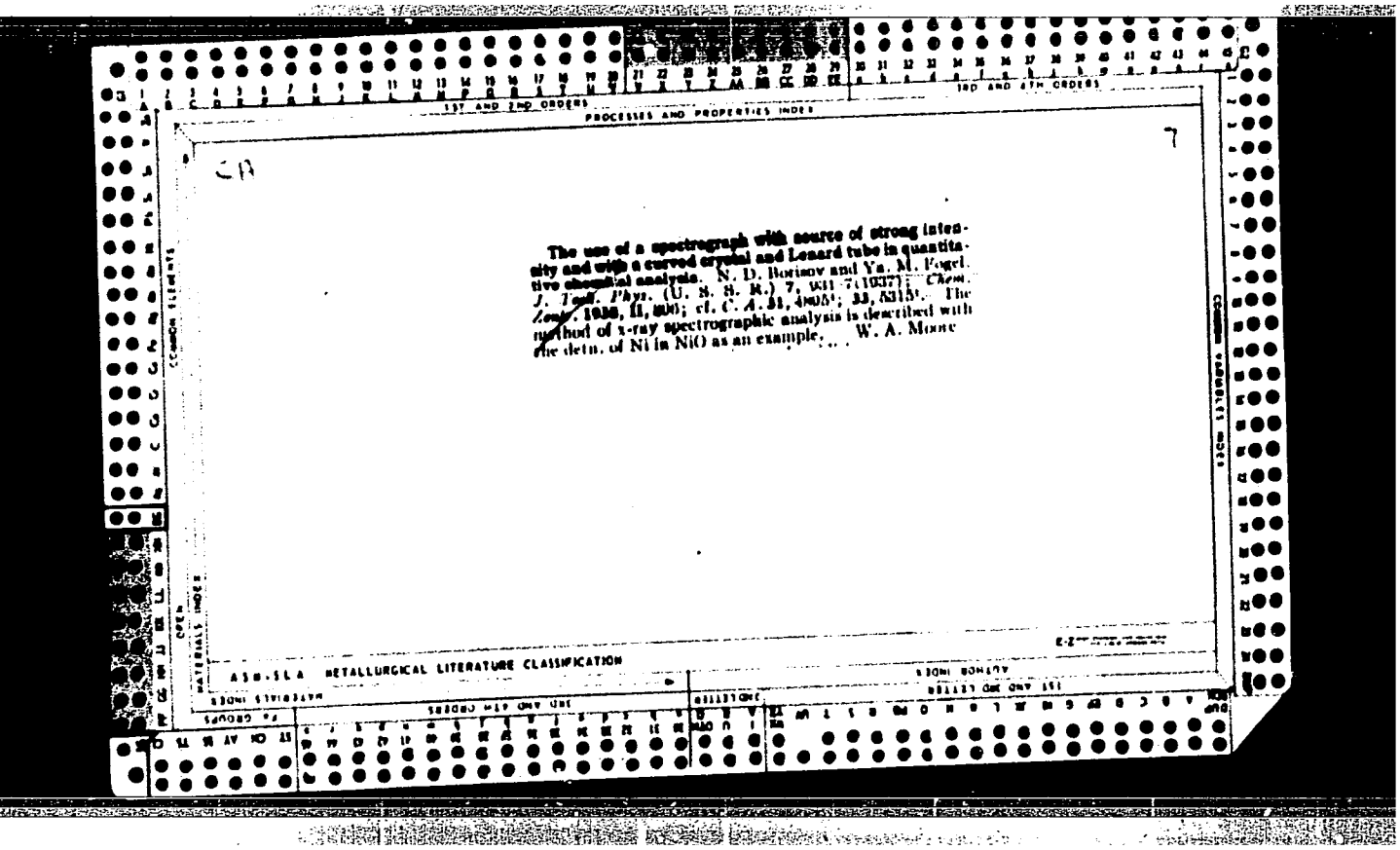
ABSTRACT: The sensitivity of photomultipliers can be significantly increased by their cooling. The authors studied the effect cooling has on FEU-64, -51, -27, -15a, 6094BEMI, and FEU-46 photomultiplier sensitivity and the number of dark pulses. Results are presented in the form of diagrams giving, as a function of wave length of incident light, 1) the ratio of the low temperature to room temperature sensitivity; 2) the signal-to-background ratio at room temperature; and 3) signal-to-background ratio at low (-70 or -180C, depending on the type of photocathode) temperature. On the basis of these results, the authors estimate the threshold flux for better samples of the photomultipliers. Orig. art. has: 4 figures and 2 tables.

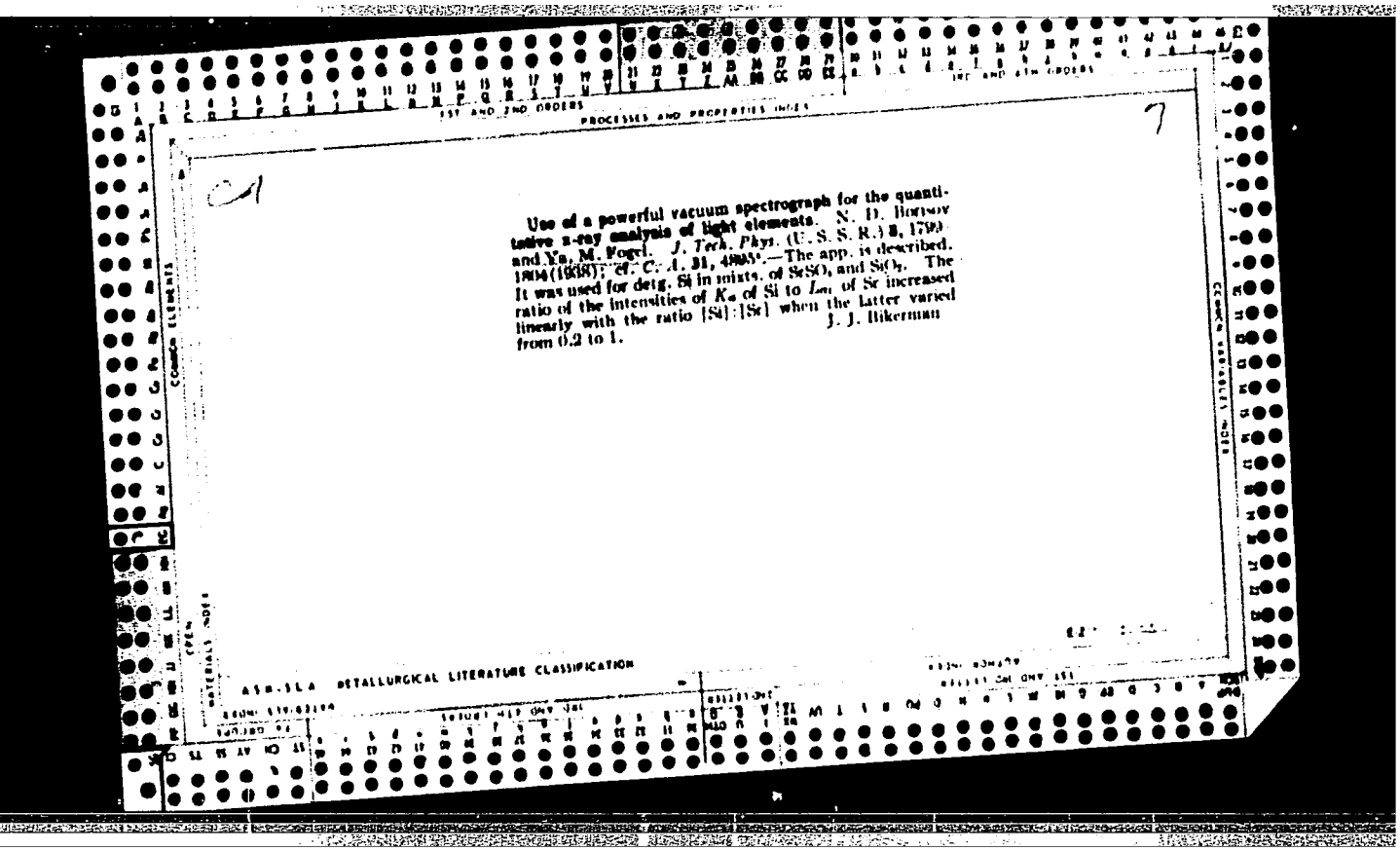
SUB CODE: OP / SUBM DATE: 07Sep64 / ORIG REF: 003 / OTH REF: 005

Card 1/1 UDC: 621.383.292

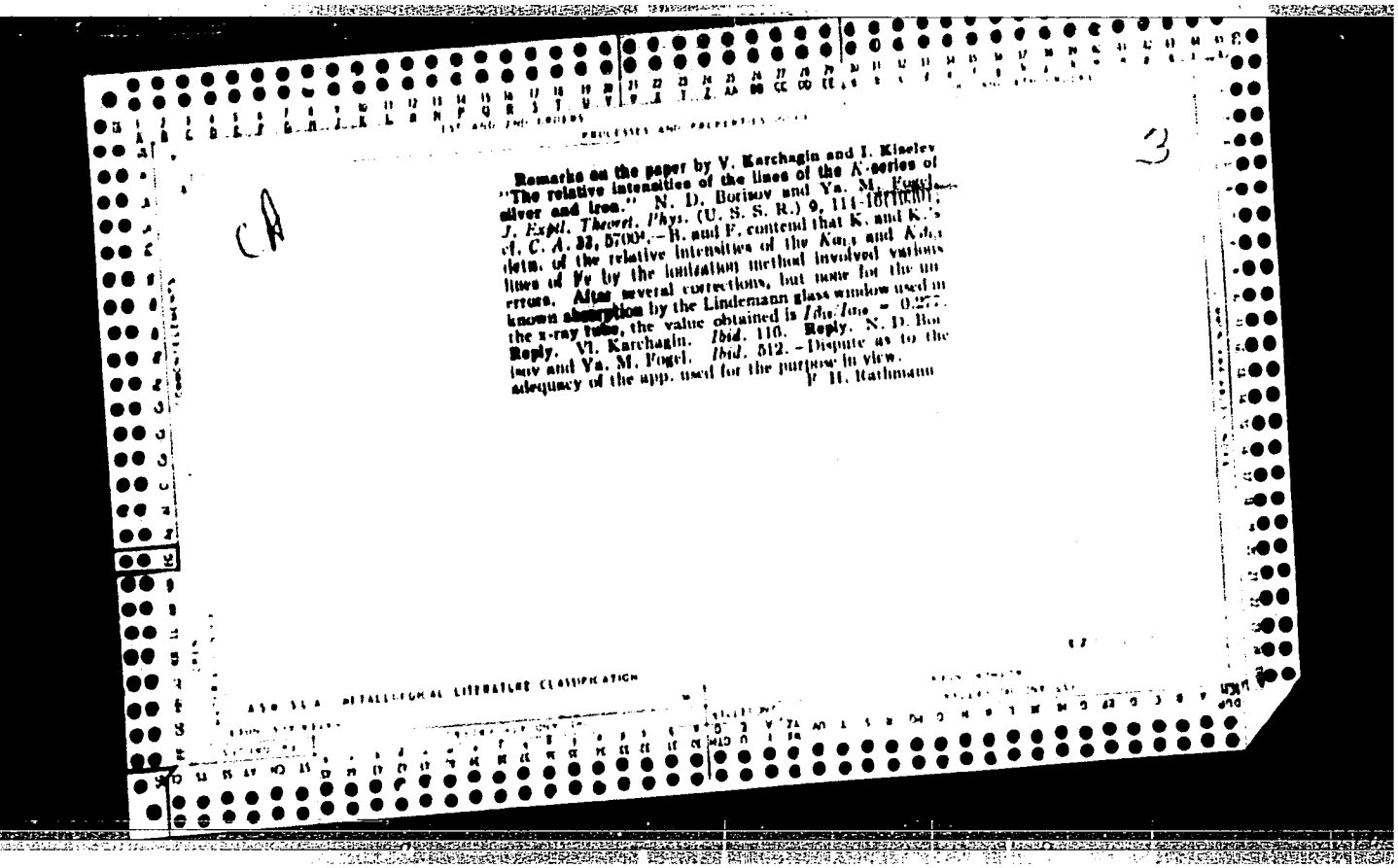


X-ray spectrograph with a curved crystal. N. Ibatova and Ya. Vogel. *Tech. Phys. U.S.S.R.* 3, 1937 (in Russian). The design of an x-ray spectrograph with a curved crystal is described. This spectrograph does not require adjustment of the crystal holder and slit holder. The method of operating the instrument is given. Reproductions are given of K and L emission spectra, K absorption spectra and K secondary spectra obtained with the curved mica crystal. H. G.



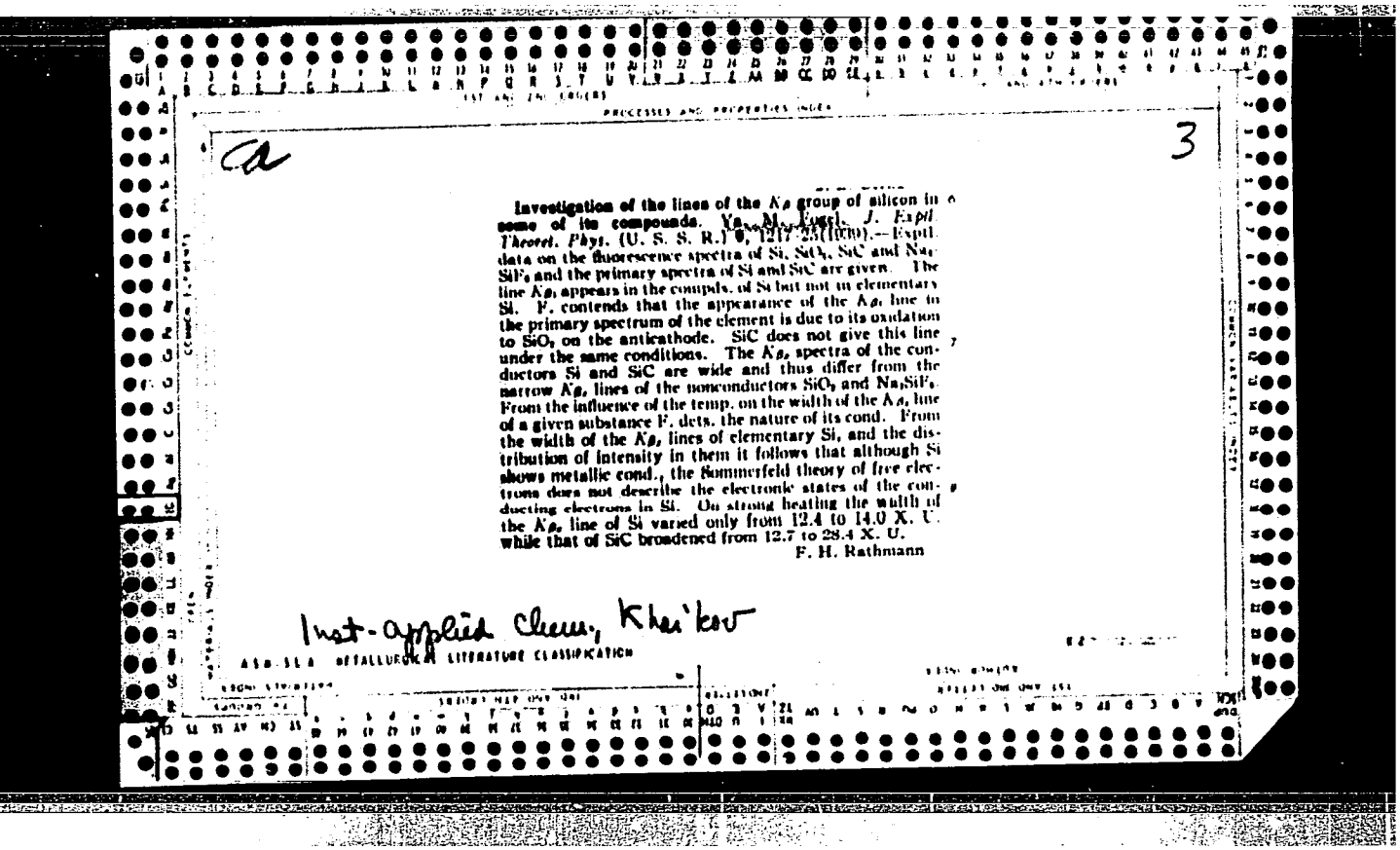


Use of a powerful vacuum spectrograph for the quantitative x-ray analysis of light elements. N. D. Borisov and Ya. M. Fogel. *J. Tech. Phys.* (U. S. S. R.) **8**, 1799-1804 (1938); cf. *C. A.* **31**, 4905⁹.—The app. is described. It was used for detg. Si in mixts. of SrSO$_4$ and SiO$_2$. The ratio of the intensities of K_α of Si to L_α of Sr increased linearly with the ratio [Si]:[Sr] when the latter varied from 0.2 to 1.
J. J. Bikerman



Remarks on the paper by V. Karchagin and I. Kiselev "The relative intensities of the lines of the K-series of silver and iron." N. D. Borisov and Ya. M. Fogel. *J. Exptl. Theoret. Phys.* (U. S. S. R.) 9, 111-[illegible]; cf. *C. A.* 32, 5700[illegible]. – B. and F. contend that K. and K.'s data, of the relative intensities of the $K\alpha_1$ and $K\alpha_2$ lines of Fe by the ionization method involved various errors. After several corrections, but none for the unknown absorption by the Lindemann glass window used in the x-ray tube, the value obtained is $I_{K\alpha_2}/I_{K\alpha_1} = 0.[illegible]$. Reply. V. Karchagin. *Ibid.* 116. Reply. N. D. Borisov and Ya. M. Fogel. *Ibid.* 512. – Dispute as to the adequacy of the app. used for the purpose in view.

F. H. Rathmann



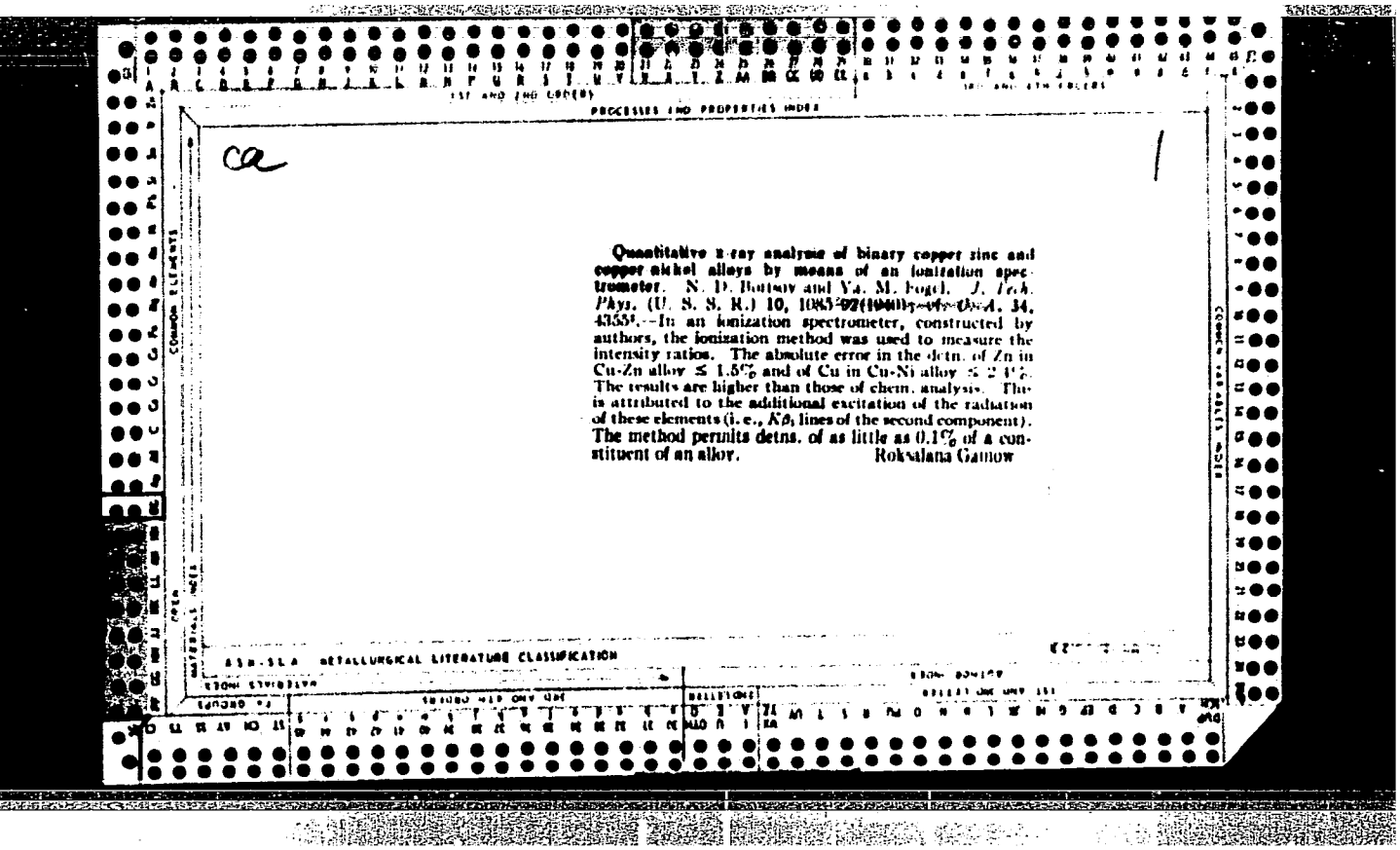
a

3

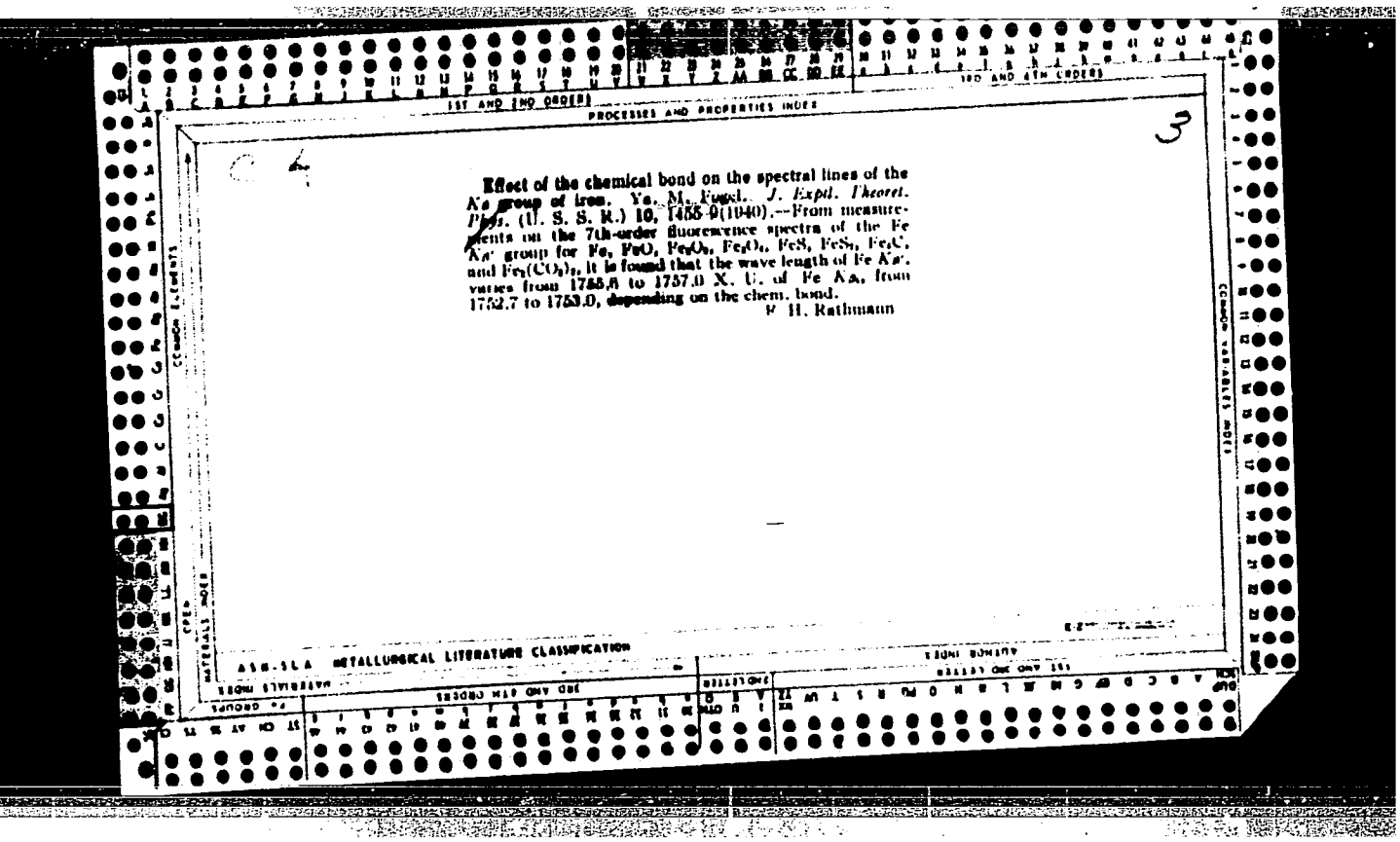
Investigation of the lines of the $K\beta$ group of silicon in some of its compounds. Ya. M. Fogel'. *J. Exptl. Theoret. Phys.* (U. S. S. R.) 9, 1217-25 (1939).—Exptl. data on the fluorescence spectra of Si, SiO_2, SiC and Na_2SiF_6 and the primary spectra of Si and SiC are given. The line $K\beta_2$ appears in the compds. of Si but not in elementary Si. F. contends that the appearance of the $K\beta_2$ line in the primary spectrum of the element is due to its oxidation to SiO_2 on the anticathode. SiC does not give this line under the same conditions. The $K\beta_2$ spectra of the conductors Si and SiC are wide and thus differ from the narrow $K\beta_2$ lines of the nonconductors SiO_2 and Na_2SiF_6. From the influence of the temp. on the width of the $K\beta_2$ line of a given substance F. dets. the nature of its cond. From the width of the $K\beta_2$ lines of elementary Si, and the distribution of intensity in them it follows that although Si shows metallic cond., the Sommerfeld theory of free electrons does not describe the electronic states of the conducting electrons in Si. On strong heating the width of the $K\beta_2$ line of Si varied only from 12.4 to 14.0 X. U. while that of SiC broadened from 12.7 to 28.4 X. U.

F. H. Rathmann

Inst-applied Chem., Khar'kov



Quantitative x-ray analysis of binary copper zinc and copper nickel alloys by means of an ionization spectrometer. N. D. Borisov and Ya. M. Fogel. *J. Tech. Phys.* (U. S. S. R.) 10, 1085-97(1940); cf. *C.A.* 34, 4355⁹.—In an ionization spectrometer, constructed by authors, the ionization method was used to measure the intensity ratios. The absolute error in the detn. of Zn in Cu-Zn alloy ≤ 1.5% and of Cu in Cu-Ni alloy ≤ 2.4%. The results are higher than those of chem. analysis. This is attributed to the additional excitation of the radiation of these elements (i. e., $K\beta_1$ lines of the second component). The method permits detns. of as little as 0.1% of a constituent of an alloy. Roksalana Gamow



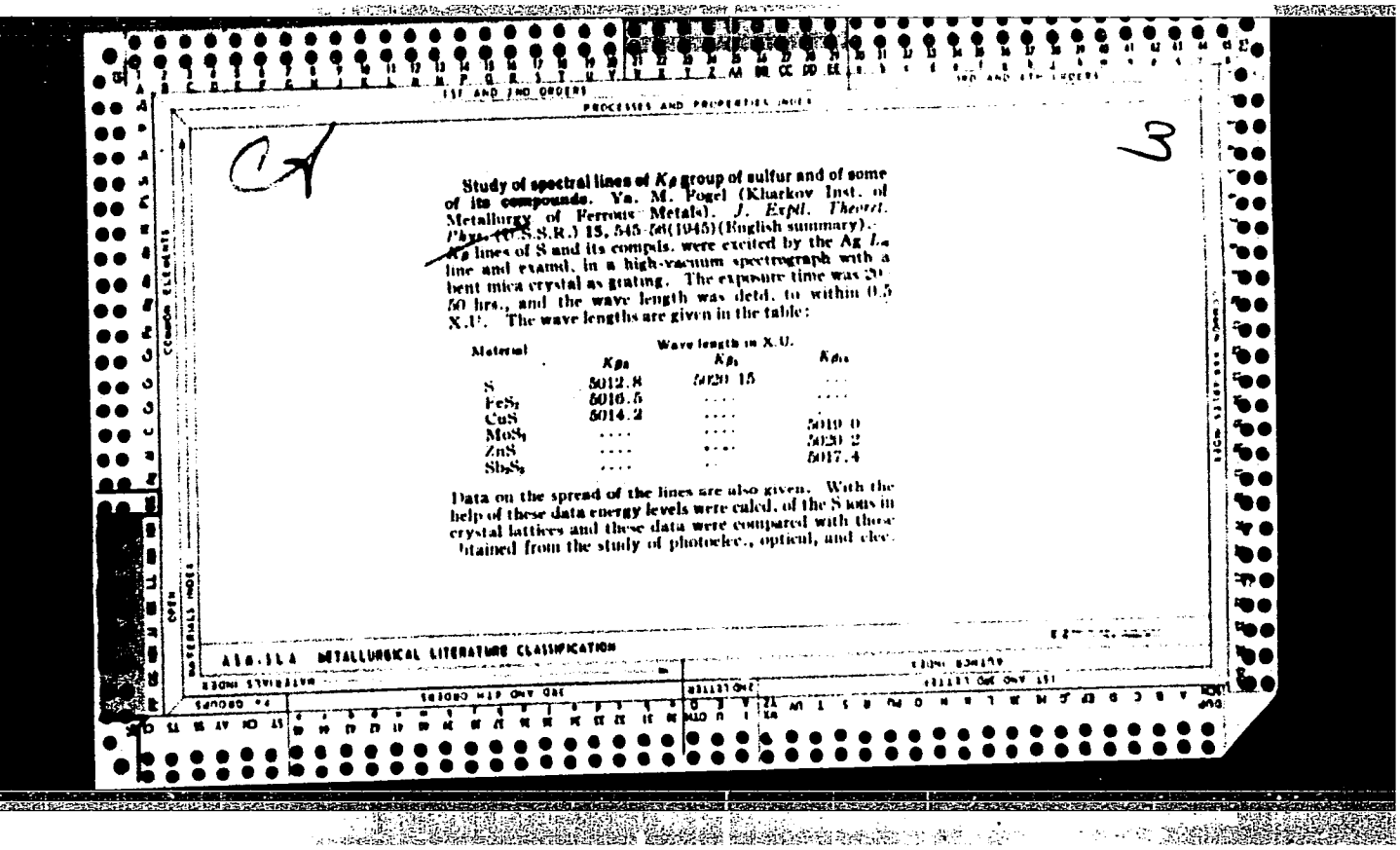
PROCESSES AND PROPERTIES INDEX

C 4

3

Effect of the chemical bond on the spectral lines of the $K\alpha$ group of iron. Ya. M. Fogel. *J. Expil. Theoret. Phys.* (U. S. S. R.) 10, 1455-9(1940).—From measurements on the 7th-order fluorescence spectra of the Fe $K\alpha'$ group for Fe, FeO, Fe_3O_4, Fe_2O_3, FeS, FeS_2, Fe_3C, and $Fe_2(CO_3)_3$, it is found that the wave length of Fe $K\alpha'$ varies from 1755.8 to 1757.0 X. U. of Fe $K\alpha_1$ from 1752.7 to 1753.0, depending on the chem. bond.
P. H. Rathmann

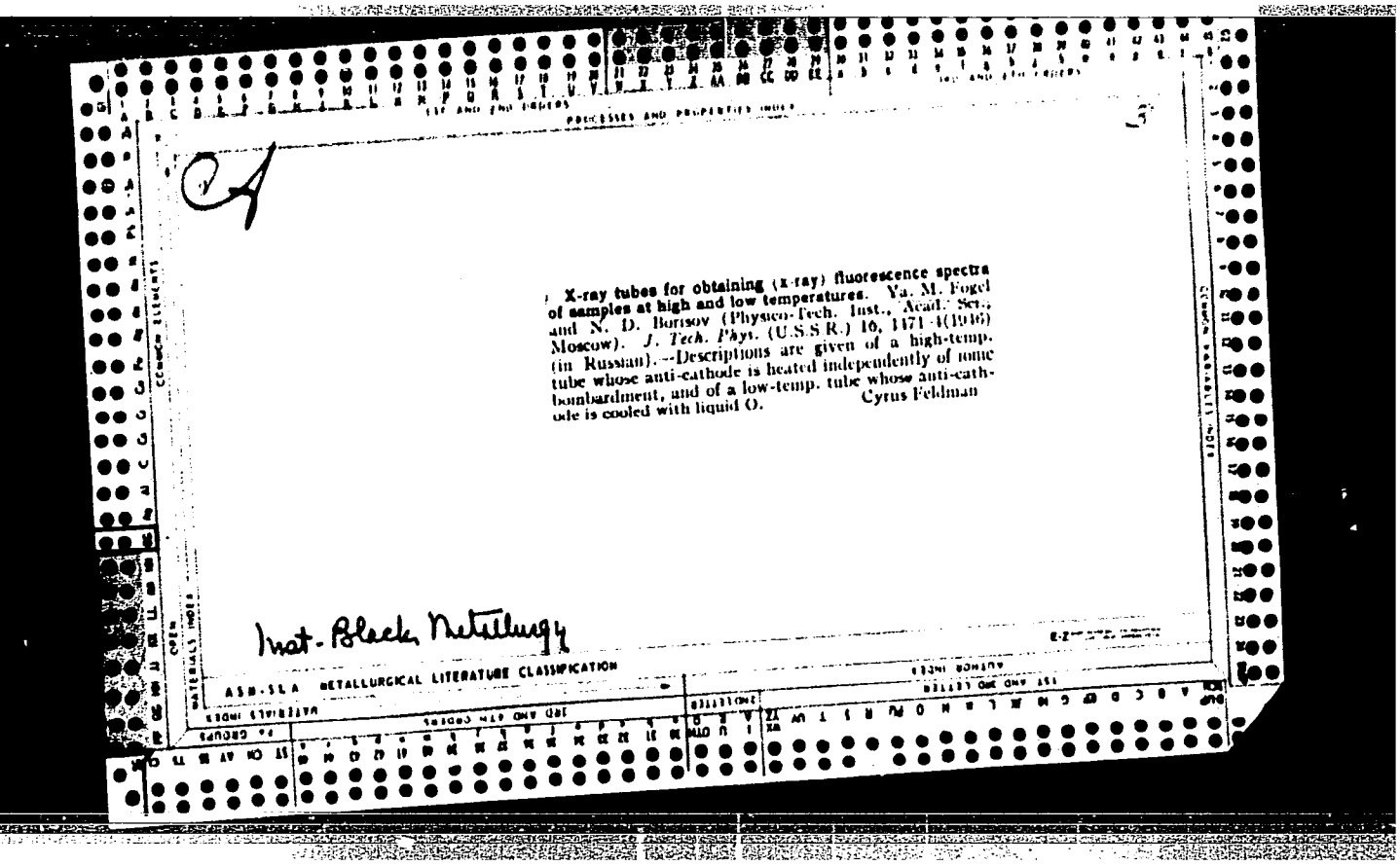
A58-SLA METALLURGICAL LITERATURE CLASSIFICATION



Study of spectral lines of K_β group of sulfur and of some of its compounds. Ya. M. Fogel (Kharkov Inst. of Metallurgy of Ferrous Metals). *J. Exptl. Theoret. Phys. (U.S.S.R.)* 15, 545-56(1945)(English summary).—K_β lines of S and its compds. were excited by the Ag L_α line and examd. in a high-vacuum spectrograph with a bent mica crystal as grating. The exposure time was 20-50 hrs., and the wave length was detd. to within 0.5 X.U. The wave lengths are given in the table:

Material	Wave length in X.U. K_{β_2}	K_{β_1}	$K_{\beta_{1,3}}$
S	5012.8	5020.15	....
FeS_2	5016.5	....	....
CuS	5014.2	....	....
MoS_2	....	....	5019.0
ZnS	....	....	5020.2
Sb_2S_3	....	....	5017.4

Data on the spread of the lines are also given. With the help of these data energy levels were calcd. of the S ions in crystal lattices and these data were compared with those obtained from the study of photoelec., optical, and elec.



X-ray tubes for obtaining (x-ray) fluorescence spectra of samples at high and low temperatures. Ya. M. Fogel and N. D. Borisov (Physico-Tech. Inst., Acad. Sci., Moscow). *J. Tech. Phys.* (U.S.S.R.) 16, 1471-4(1946) (in Russian).--Descriptions are given of a high-temp. tube whose anti-cathode is heated independently of ionic bombardment, and of a low-temp. tube whose anti-cathode is cooled with liquid O.

Cyrus Feldman

Inst. Black Metallurgy

CM

Use of the Geiger-Müller counter in the chemical analysis of small concentrations of elements in various substances. N. D. Borisov and Ya. M. Fogel. *Zhur. Tekh. Fiz.* (J. Tech. Phys.) 17, 599-612(1947). In Russian. G.-M. counter, connected with an x-ray ionization spectrometer, gives a count proportional to the intensity of the weak x-ray line characteristic of the element, which is proportional to the concn. of the element. With a bronze sample contg. a little Fe, it is shown that if the sample is mounted as primary anticathode, the contrast between the intensity at the peak of the FeK$_\alpha$ doublet and that at the foot of the peak is unfavorable for detn., and is hardly improved by an increase of the voltage. Conditions become markedly more favorable if the sample is used as secondary anticathode. The method was tested for the detn. of Ni in Co preps., of Fe in Be foil and in brass, and for a complete nondestructive analysis of an imported metallic ribbon of unknown compn., identified as, mainly, a Cu-Ag alloy. N. Thon

PA 174T81

USSR/Physics - Molecular Beams Jan 51
Magnetic Field, Nonhomo-
geneous

"Focusing of a Molecular Beam by a Nonhomogeneous Magnetic Field," M. I. Korsunskiy, Ya. M. Fogel', Physicotech Inst, Acad Sci Ukrainian SSR

"Zhur Eksper i Teoret Fiz" Vol XXI, No 1, pp 25-37

Indicates various types of nonhomogeneous magnetic fld which permit one to realize double focusing of mol beam, and considers motion of mol in these fld taking into account action of gravitational force.

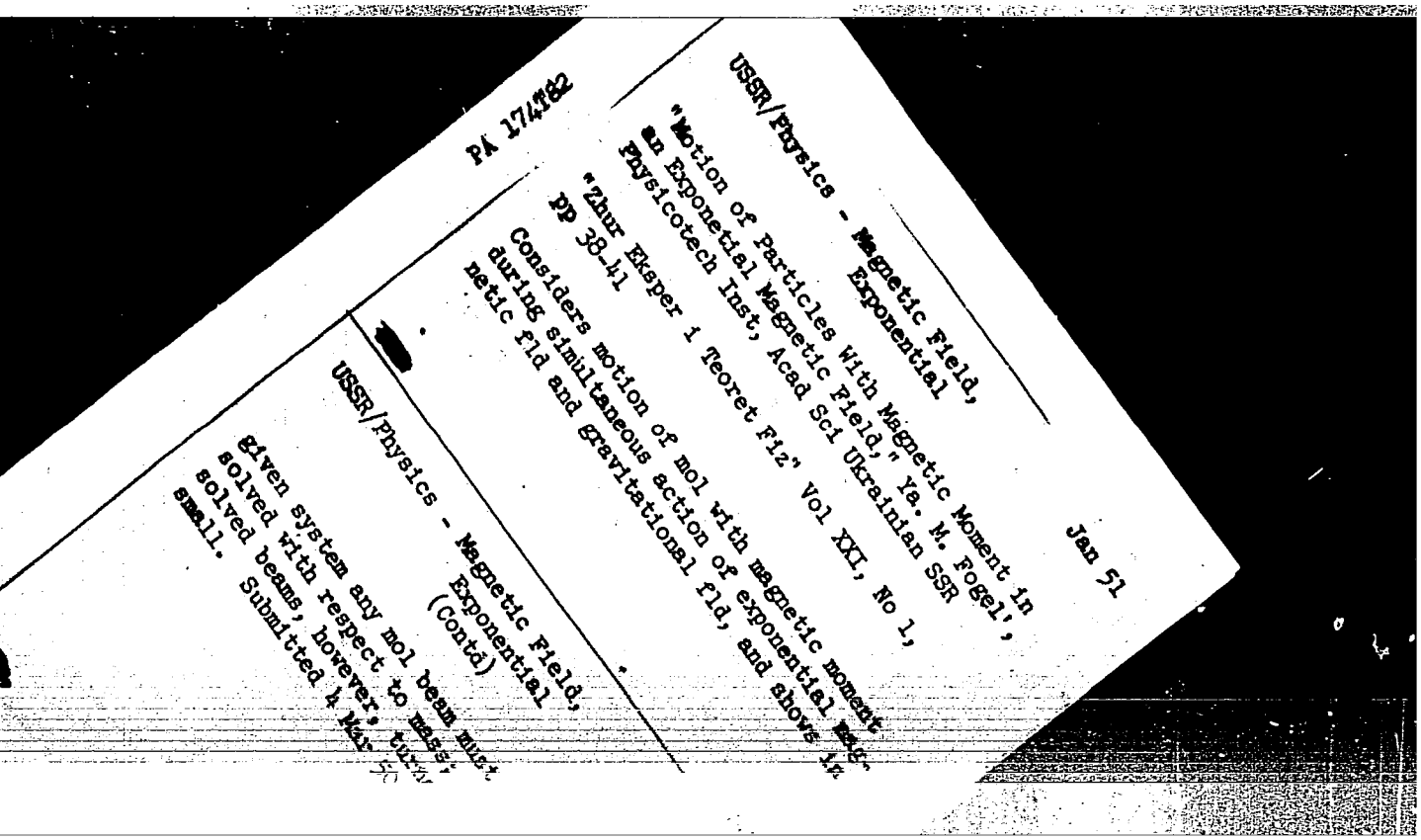
174T81

USSR/Physics - Molecular Beams Jan 51
(Contd)

Shows that with aid of 2-dimensional nonhomogeneous magnetic fld discussed here one can realize lenses for mol beams. Submitted 18 Aug 50.

174T81

FOGEL', Ya. M.



PA 174382

USSR/Physics - Magnetic Field, Exponential Jan 51

"Motion of Particles With Magnetic Moment in an Exponential Magnetic Field," Ya. M. Fogel', Physicotech Inst, Acad Sci Ukrainian SSR

"Zhur Eksper i Teoret Fiz" Vol XXI, No 1, pp 38-41

Considers motion of mol with magnetic moment during simultaneous action of exponential mag- netic fld and gravitational fld, and shows it

USSR/Physics - Magnetic Field, Exponential (Contd)

given system any mol beam must solved with respect to mass, solved beams, however, turn small. Submitted 4 Mar 50

FOGEL, YA. M.

PA 174T82

USSR/Physics - Magnetic Field, Exponential

Jan 51

"Motion of Particles With Magnetic Moment in an Exponetial Magnetic Field," Ya. M. Fogel', Physicotech Inst, Acad Sci Ukrainian SSR

"Zhur Eksper i Teoret Fiz" Vol XXI, No 1, pp 38-41

Considers motion of mol with magnetic moment during simultaneous action of exponential magnetic fld and gravitational fld, and shows in

174T82

USSR/Physics - Magnetic Field, Exponential (Contd)

Jan 51

given system any mol beam must be sepd or resolved with respect to mass; intensity of resolved beams, however, turns out to be very small. Submitted 4 Mar 50.

174T82

FOGEL, YA. M.

A.M.; LISOCHKIN, G.A.; STEPANOVA, G.I.

Supersonic flow of mercury vapor in vacuo. Zhur.tekh.fiz.25 no.11: (MLRA 9:1)
1944-1953 0 '55.
(Ultrasonics) (Ion beams)

Fogel, Ya. M.

USSR/Physics - Electron capture FD-2205

Card 1/2 Pub 146-10/25

Author : Fogel', Ya. M.; Krupnik, L. I.; Safronov, B. G.

Title : Capture of electrons and ionization of protons in hydrogen

Periodical : Zhur. eksp. i teor. fiz. 28, 589-602, May 1955

Abstract : By means of a perfected method of collecting slow particles onto a measuring electrode of a flat condenser the authors measure in the energy interval 12.3 to 36.7 keV the effective cross-sections of capture of one electron and ionization by protons in hydrogen. They compare the obtained results with the data of other works and with the data theoretical calculations. In the passage of protons through hydrogen they observe negative ions of hydrogen in the beam past. They show that for small pressures of the gas in the chamber of collisions the appearnace of negative ions of hydrogen in the past beam is connected with the process of capture by a proton of two electrons in the hydrogen molecule. The oriented measurement of the effective cross-section of this process for protons with energy 13, 21, and 31.4 keV indicates that the presence of this process cannot essentially alter the results of the measurement

of the effective cross-section of capture of a single electron by the method of collecting slow particles. The authors thank Professor A. K. Val'ter. Eleven references, including one USSR (M. M. Bredov and N. V. Fedorenko, Zhur. tekhn. fiz. 20, 1950).

Insitution : Physicotechnical Institute, Academy of Sciences Ukrainian SSR

Submitted : April 3, 1954

USSR/Physics - Proton passage through foil FD-2345

Card 1/1 Pub. 146 - 10/34

Author : Fogel', Ya. M.; Safroncv, B. G.; and Krupnik, L. I.

Title : Formation of hydrogen negative ions in the passage of protons through thin metal foils

Periodical : Zhur. eksp. i teor. fiz. 28, 711-718, Jun 1955

Abstract : By means of a double mass-spectrometric arrangement the authors determined the ratios of the number of negative hydrogen ions to the number of protons in the beam formed after the passage of protons with energies in the interval 11.5 to 28 kev through thin foils of Be, Al, and Cu. They show that about 10% of the protons incident upon a thin foil of Be can be transformed into negative hydrogen ions. They thank Professor A. K. Val'ter. Five references including one USSR: Ya. M. Fogel' et alii, ibid. 28, 1955.

Institution : Physicotechnical Institute, Academy of Sciences Ukrainian SSR

Submitted : April 3, 1954

USSR/Physics - Negative ions of oxygen FD-2874

Card 1/1 Pub. 146 - 11/26

Author : Fogel', Ya. M.; Krupnik, L. I.

Title : Formation of negative oxygen ions during collisions of positive oxygen ions with gas molecules

Periodical : Zhur. eksp. i teor. fiz., 29, August 1955, 209-220

Abstract : By means of a double mass-spectrometer arrangement the authors study the processes of capture of two electrons by positive atomic and molecular ions of oxygen during collisions with molecules of hydrogen, oxygen and nitrogen. They measure the effective cross sections of these processes for oxygen ions with energies from 14 to 41 kev. Their purpose is a more detailed study of the following process: $A^{+} + B \rightarrow A^{-} + B^{++}$. The authors thank Professor A. K. Val'ter. Sixteen references: e.g. N. I. Ionov, ibid., 10, 1248, 1940 and 18, 174, 1948; V. I. Veksler and G. N. Shuppe, Zhur. tekhn. fiz., 23, 1573, 1953; N. Massey and E. Burchop, Electronic and Ionic Impact Phenomena, Oxford, 1952.

Institution : Physicotechnical Institute, Academy of Sciences Ukrainian SSR

Submitted : April 3, 1954

FOGEL, Ya. M.

Category : USSR/Magnetism - Experimental methods of magnetism F-2

Abs Jour : Ref Zhur - Fizika, No 1, 1957 No 1389

Author : Korsunskiy, M.I., Fogel', Ya.M., Bykova, G.A., Livshits, L.I., Lozovskiy, N.S. Chovnik, A.A.

Title : Investigation of the Topography of the Inhomogeneous Plane Magnetic Field of a Six-Pole Electromagnet.

Orig Pub : Zh. tekhn. fiziki, 1956, 26, No 2, 1222-1232

Abstract : A procedure is described for the investigation of the topography of an inhomogeneous plane magnetic field of a six-pole electromagnet, used to focus particles that have a magnetic moment. The cited measurement results show that the above field can be produced without substantial distortion in a circle 10 cm in radius.

Card : 1/1

FOGEL, YA.M.

USSR/Physical Chemistry - Atom B-3

Abs Jour: Ref Zhur-Khimiya, No 5, 1957, 14338

Author : Fogel Ya. M., Krupnik L I., and Ankudinov V. A.
Inst : -
Title : Formation of negative hydrogen ions during passage of positive hydrogen ions through an ultrasonic stream of mercury vapor

Orig Pub: Zh. tekhn. fiziki, 1956, 26, No 6, 1208-1221.

Abstract: A description is given of the installation and procedure for obtaining negative hydrogen ions which are formed during the passage of a positive ion beam of hydrogen through an ultrasonic stream of mercury vapor. Investigations have shown that the greatest number of negative hydrogen ions is formed for proton energies of the order of 25 kev and a stream depth corresponding to a mercury temperature ~160° in the boiler (for the conversion of $H^+1 \rightarrow H^-1$). The loss of mercury atoms from the stream is negligible and it became possible to

Card 1/2

USSR/Physical Chemistry - Atom B-3

Abs Jour: Ref Zhur-Khimiya, No 5, 1957, 14338

Abstract: exclude from the system the mass-monochromator. The thus simplified installation is a source of negative ions with an intensity of a greater order than in the Fait gas-discharge source.

Card 2/2

FOGEL', Ya. M.

USSR/Nuclear Physics - Penetration of Charged and Neutral Particles Through Matter, C-6

Abst Journal: Referat Zhur - Fizika, No 12, 1956, 34101

Author: Fogel', Ya. M., Mitin, R. V.

Institution: Physicotechnical Institute, Academy of Sciences Ukrainian SSR, Khar'kov State University

Title: Formation of Negative Ions of Hydrogen During Collision of Protons with Gas Molecules

Original Periodical: Zh. eksperim. i teor. fiziki, 1956, 30, No 3, 450-457

Abstract: The capture cross sections of 2 electrons were measured during proton collisions of 9.5-29 kev with molecules of H_2, N_2, O_2, He, Ne, and Ar. The energy dependence of the ratio of the number of negative ions of hydrogen to the number of protons in a balanced beam, formed after the passage of the proton beam through the gas targets made of the above 6 gases, is determined. Based on the data obtained, the capture cross section of one electron was calculated for a collision of a fast hydrogen atom with a H_2 molecule.

1 of 1

FOGEL', Ya. M.

SUBJECT USSR / PHYSICS CARD 1 / 2 PA - 1617
AUTHOR FOGEL', JA.M., MITIN, R.V., KOVAL', A.G.
TITLE The Study of the Capturing Processes of Two Electrons on the Occasion of Collisions of Positive Carbon- and Oxygen Ions with Gas Molecules.
PERIODICAL Zurn. eksp. i. teor. fis, 31, fasc.3, 397 - 404 (1956)
Issued: 12 / 1956

The present work measures the cross sections of the twofold charge exchange on the occasion of the passage of C_1^+ - and O_1^+ -ion bundles through Ne, He, A, Kr, Xe, H_2, N_2, and O_2.

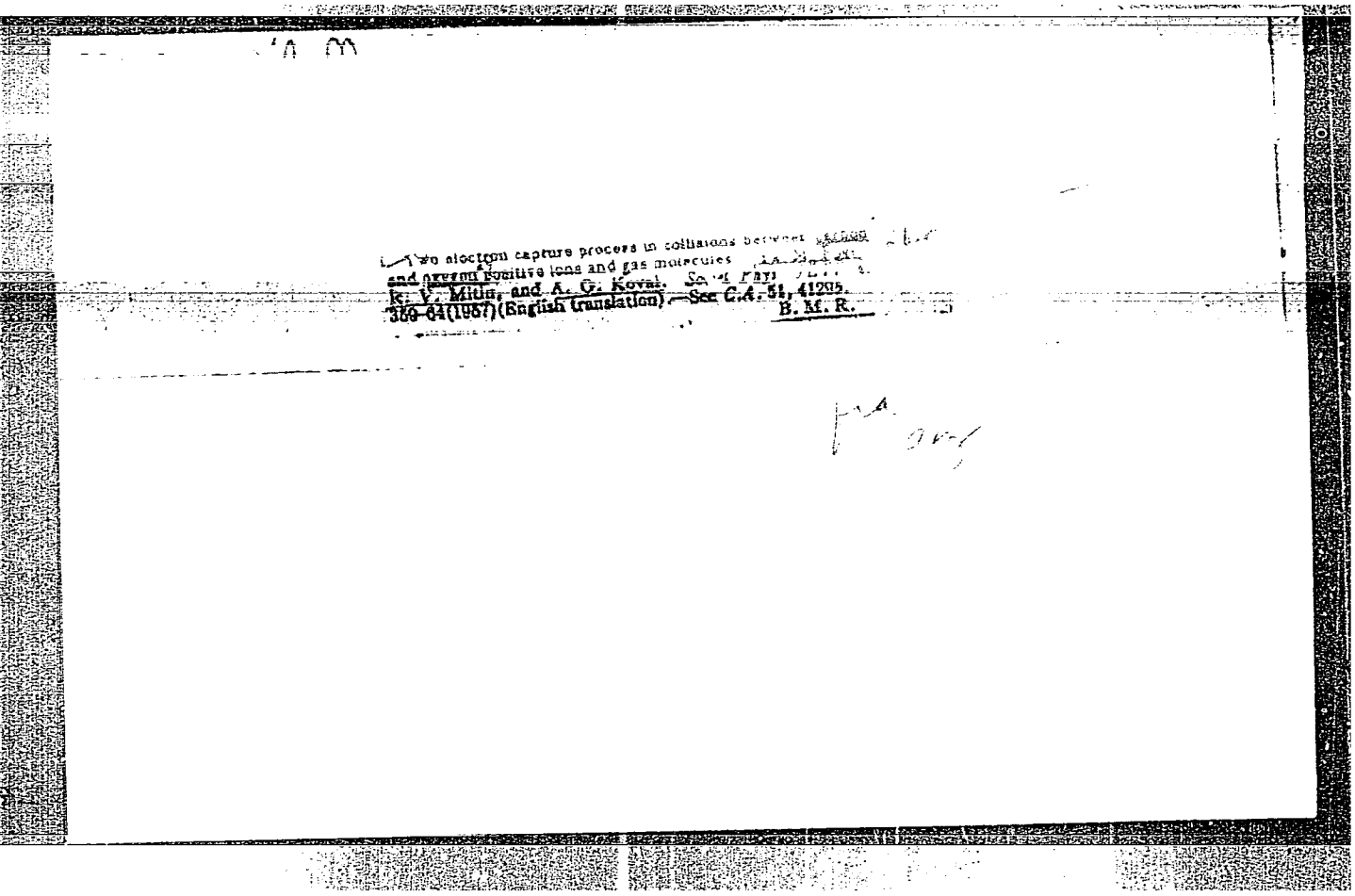
Apparatus and measuring method: These double charge exchange processes were investigated by means of a double mass spectrometer. The bundles of the C_1^+ - and O_1^+ - ions were produced by blowing oxygen gas through a bimetallic valve into a high frequency ion source. The bundle of the C_1^+ - and O_1^+ - ions also contained considerable quantities of CO^+ - and CO_2^+ - ions as well as small quantities of H_1^+, H_2^+, H_3^+, N_1^+ - ions.

Discussion of measuring results: The aforementioned cross sections of the twofold charge exchange were investigated within the energy interval of from 10,7 to 54,5 keV. The results obtained are illustrated by two diagrams. Within the energy interval investigated the cross section $\sigma_{1\,1}$ of the capture of two electrons by C_1^+ - ions in He, Ne, A, Xe, H_2 and N_2 as well as by O_1^+ - ions in He, Ne, and N_2 increases monotonously with increasing ion energy. The velocity of the increase of σ_{1-1} on this occasion diminishes with increasing ion energy, which is indicative of an approximation towards a maximum. For O_1^+ - ions in A, Kr, H_2, O_2 the cross

Zurn.eksp.i.teor.fis, 31, fasc.3, 397 - 404 (1956) CARD 2 / 2 PA - 1617

section σ_{1-1} beginning from about 30 keV up to the end of the interval remains constant and σ_{1-1} remains constant in two further cases, namely for C_1^+ in Kr between 27 and 32 MeV as well as for C_1^+ in O_2 between 32 and 43 MeV. However, in these cases there is a new increase of σ_{1-1} behind this plateau. Only in the case of O_1^+ in Xe does σ_{1-1} have a flat maximum at ~30 keV within the energy interval investigated. The amount of σ_{1-1} for a given ion changes within very wide limits: For C_1^+ from $3{,}2.10^{-20}$ cm^2 (in He; 32,4 KeV) up to $6{,}4.10^{-17}$ cm^2 (in Xe at 54,5 keV). σ_{1-1} depends to a considerable extent on the purity of the gas in which the electrons are captured. At the same energy σ_{1-1} increases for C_1^+ - and O_1^+ - ions in the following order: He, Ne, H_2, N_2, O_2, A, Kr, Xe. An exception to this rule is mentioned. From these and other results the following conclusions are drawn: σ_{1-1} decreases with an increase of the energy binding the electrons to the particle losing them. σ_{1-1} increases with increasing binding energy of the electrons in the negative ion which is created. The defect of the resonance process is not a universal parameter for the determination of the cross section of the twofold charge exchange in the case of any ion molecule pair. The elucidation of the general character of these conclusions requires further investigations.

INSTITUTION: Physical - Technical Institute of the Academy of Sciences of the Ukrainian SSR.



Two electron capture process in collisions between
and oxygen positive ions and gas molecules
K. V. Mitin, and A. G. Koval. Sov. Phys.
369-84(1987)(English translation) See C.A. 51, 41205.
B. M. R.

AUTHOR: FOGEL',Ya.M., KRUPNIK,L.I., SLABOSPITSKIY,R.P. PA - 3551

TITLE: Negative Hydrogen Ion Formation by Passage of Positive Hydrogen Ions through a Supersonic Oil Vapour Stream. (Obrazovaniye otritsatel'nykh ionov vodoroda pri prokhozhdenii polozhitel'nykh ionov vodoroda cherez sverkhzvukovuyu struyu parov masel, Russian)

PERIODICAL: Zhurnal Tekhn. Fiz., 1957, Vol 27, Nr 5, pp 981 - 987 (U.S.S.R.)

ABSTRACT: With reference to a previous work (Zhurnal Tekhn. Fiz., 1956, p 1208) several experiments are described in the present paper which were carried out with a view of realizing a vapor jet target. Oil, which has a low vapor viscosity, was used as working material. For purposes of comparison with a vapor-mercury target experiments were carried out for the determination of the coefficient of the transformation $H_1^+ \rightarrow H_1^-$ on which occasion various oils were used as target substance. The supersonic outflow of oil vapors from a Lavel nozzle was investigated in a system, the section of which is shown here. The results obtained by the investigations make it possible to investigate the transformation of positive hydrogen ions into negative ones in the ultrasonic jet of the oil vapors. Three groups of H_1^--ions were observed: 1) such with an energy that corresponded to the full potential drop, 2) and 3) with an energy that corresponded to one half and one third of this value respectively. The experiments showed that a reliable vapor jet

Card 1/2

PA - 3551

Negative Hydrogen Ion Formation by Passage of Positive Hydrogen Ions through a Supersonic Oil Vapor Stream.

target, in the case of which oil with low vapor pressure is used as working substance, can be realized. For butyl-sebacat oil the possibility is shown of producing a vapor jet target with a water-cooled condenser. The coefficient of the transformation of the positive ions into negative ones in a vapor oil target is lower by about one half than that in the vapor-mercury target. Therefore the latter must be preferred for this transformation. (9 illustrations and 2 Slavic references)

ASSOCIATION: FTI of the Academy of Science of the U.S.S.R., Charkov
PRESENTED BY:
SUBMITTED: 6.11.1956
AVAILABLE: Library of Congress

Card 2/2

FOGEL', Ya.M.

AUTHOR: FOGEL',Ya.M., KRUPNIK,L.I., KOVAL',A.G., PA - 3552
SLABOSPITSKIY,R.P.

TITLE: Composition of Equilibrium Beam, Formed by Passage of Single Positive Oxygen Ions through the Gas Targets. (Sostav ravnovesnogo puchka, obrazuyushchegosya pri prokhozhdenii odnozaryadnykh polozhitel'nykh ionov kisloroda cherez gazovyye misheni, Russian)

PERIODICAL: Zhurnal Tekhn. Fiz., 1957, Vol 27, Nr 5, pp 988 - 996 (U.S.S.R.)

ABSTRACT: The tests were carried out in order, by means of a recharge of positive ions, to obtain a bundle of negative oxygen ions. For this purpose the composition of an equilibrium oxygen bundle with an energy of 12.3 - 46.2 keV, which is formed during the passage of positive oxygen ions with a charge through a flowing gas target filled with Ne-, A-, H_2-, N_2-, and O_2 gases, is investigated.

There follows the description of the apparatus and of the measuring method. The quantities f^0, f^+, f^- (relative content of positive and negative ions with a charge in the bundle) for an equilibrium oxygen bundle with an energy in the above interval in the above mentioned gases were investigated. It is shown that in the energy interval investigated no great dependence of bundle composition on energy could be observed. However, the composition of the bundle depends in a high degree on the nature of the gas by which the target is filled. There is a particularly high content

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PA - 3552

Composition of Equilibrium Beam, Formed by Passage of Single Positive Oxygen Ions through the Gas Targets.

of negative ions in the bundle which was formed in a target filled with hydrogen and argon. For argon the quantity f^- in the interval of 27 - 33.5 keV amounts to up to 3%. Comparison shows that the content of negative ions in an equilibrium oxygen bundle is considerably greater than that in an equilibrium hydrogen bundle. The investigation carried out here allows the assumption that a flowing target filled with argon might be quite effective with respect to obtaining intense bundles of negative oxagen ions. (2 tables, 6 illustrations, and 7 Slavic references)

ASSOCIATION: FTI of the Academy of Science of the U.S.S.R., Charkov
PRESENTED BY:
SUBMITTED: 6.11.1956
AVAILABLE: Library of Congress

Card 2/2

Fogel', Ya.M.

57-9-27/40

AUTHOR: Timofeyev, A.D., Fogel', Ya.M.

TITLE: On the Dividing of the Atomic Bundle into Components with Oriented Spin of the Electron Shell by Means of the Exponential Magnetic Field
(O razdelenii atomnogo puchka na komponenty s oriyentirovannym spinom elektronnoy obolochki s pomoshch'yu eksponentsial'nogo magnitnogo polya)

PERIODICAL: Zhurnal Tekhn. Fiz., 1957, Vol. 27, Nr 9, pp. 2129 - 2133 (USSR)

ABSTRACT: A calculation is dealt with here, which confirms the author's (ZhETF, 21,38,1951) with respect to the following: The ponderomotoric force acting upon a particle with a magnetic moment, which is in the exponential field, is directed parallel to the median field plane and depends solely upon one coordinate. In this way it is possible to attain a considerable splitting up of the bundle with a relatively great width of slot by which the atomic beam is determined, and thus to increase the number of atoms with an oriented spin of the electron shell in the beam. Equations are derived with the aid of which it is possible to construct trajectories for hydrogen atoms in an exponential magnetic field. The number of atoms in the bundle passing through the selector gap is computed in consideration of that number of

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57-9-27/40

On the Dividing of the Atomic Bundle into Components with Oriented Spin of the Electron Shell by Means of the Exponential Magnetic Field

atoms in the bundle which passed through the collimator gap. Also the weakening of the bundle according to spins and because of the divergence of the bundle in the verticals is taken into account. The formula for the computation of the number of particles passing through the collimator is given. For the determination of this amount N_k (number of particles) the height of the gap and the hydrogen pressure in the source must be given. On the basis of Maxwell's velocity distribution of the particles in the atomic bundle the number of particles passing through the selector gap can be determined. There are 2 figures and 1 Slavic reference.

ASSOCIATION: Physical-Technical Institute, AN Ukrainian SSR, Khar'kov (Fiziko-tekhnicheskiy institut AN USSR, Khar'kov)

SUBMITTED: March 26, 1957

AVAILABLE: Library of Congress

Card 2/2

AUTHOR: FOGEL,YA.M., ANKUDINOV,V.A., SLABOSPITSKY,R.P. PA - 2956

TITLE: Loss of Two Electrons in A Single Collision between Negative Hydrogen Ions and Molecules of the Gas. (Potera dvukh elektronov pri odnokratnykh stolknoveniyakh otritsatel'nykh ionov vodoroda s molekulami gazov, Russian)

PERIODICAL: Zhurnal Eksperim. i Teoret. Fiziki, 1957, Vol 32, Nr 3, pp 453-462 (U.S.S.R.)
Received: 6 / 1957 Reviewed: 7 / 1957

ABSTRACT: The cross sections of these losses in the case of energies of hydrogen ions of from 5 to 40 keV were measured on the occasion of collisions with He-, Ne-, A-, Kr-, Xe- atoms, and H_2-, N_2-, O_2-molecules; the experimental system is described in detail. In the interval examined the cross sections in Ne, A, Xe, N_2, O_2 increase monotonously with the energy; with Kr they increase up to 20,6 keV, after which they remain constant; in the case of He a maximum exists at 20 keV, and with H_2 the cross section remains constant. These results are compared with the cross sections of the loss of two electrons in the case of heavy negative ions, of the loss of an electron by the same ions as those measured here; the justification of neglecting two-electron losses when measuring one-electron

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PA - 2956

Loss of Two Electrons in a Single Collision between Negative Hydrogen Ions and Molecules of the Gas.

losses is discussed. The results obtained do not agree with the adiabatic hypothesis by H.S.MASSEY (Rep.Progr.Phys. 12, 1026, 1951). In conclusion, the cross sections obtained are compared with the cross sections of the electron losses of helium-like electron structure (H^- and Li^+) as well as with the cross sections of the two-electron capture of a proton. (10 Illustrations, 1 Table, 25 Citations from Published Works).

ASSOCIATION: Physical-Technical Institute of the Academy of Science of the Ukrainian SSR.

PRESENTED BY:
SUBMITTED: 23.10.1956
AVAILABLE: Library of Congress

Card 2/2

Fogel, Ya.M.

AUTHOR: FOGEL,YA.M. PA - 2979

TITLE: On the Applicability of the Equation of the Detailed Equilibrium on an Ion Bundle of Steady Composition. (o primenimosti dlya puchka ionov statsionarnogo sostava sootnosheniya detal'nogo ravnovesiya, Russian)

PERIODICAL: Zhurnal Eksperim. i Teoret. Fiziki, 1957, Vol 32, Nr 3, pp 604-605 (U.S.S.R.)

Received: 6 / 1957 Reviewed: 7 / 1957

ABSTRACT: M.I.KORSUNSKY et al. (Doklady Akademii Nauk SSSR, 107, 664, 1956) concluded from their experimental data that on the occasion of an exchange of charge between the ions of the bundle and the molecules of the penetrated substances the relation $\sigma_{ik} / \sigma_{ki} = N_k / N_i$ applies, where σ_{ik} denotes the effective cross section for the transition of an ion from the state of charge i into the state of charge k, and N_k / N_i - the ratio between the ions with the charge k and those with the charge i in a bundle of steady composition. The author examined the validity of this relation by means of the processes of capture and losses of two electrons on the occasion of single collisions between protons and negative hydrogen ions respectively and hydrogen molecules by using his own experimental

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PA - 2979

On the Applicability of the Equation of the Detailed Equilibrium on an Ion Bundle of Steady Composition.

data (Zhurnal Eksperim.i Teoret. Fiziki, 30, 450, 1956, and Zhurnal Eksperim.i Teoret.Fiziki 32, 453, 1957). Here the incorrectness of the assumption mentioned is established. (1 Table, 4 Citations of Works Published.)

ASSOCIATION: Physical-Technical Institute of the Academy of Science of the U.S.S.R.
PRESENTED BY:
SUBMITTED: 15.7.1956
AVAILABLE: Library of Congress

Card 2/2

SOV/57-28-7-25/35

AUTHORS: Fogel', Ya. M., Mitin, R. V., Kozlov, V. F.

TITLE: On the Method of Measuring the Effective Cross Sections of the Formation Processes of Negative Ions in Atomic Collisions (K voprosu o metodike izmereniya effektivnykh secheniy protsessov obrazovaniya otritsatel'nykh ionov pri atomnykh stolknoveniyakh)

PERIODICAL: Zhurnal tekhnicheskoy fiziki, 1958, Vol. 28, Nr 7, pp.1526-1537 (USSR)

ABSTRACT: The processes of the formation of negative ions in atomic collisions are in a general form expressed by formula (1). However, for the measurement of the effective cross sections of the process a new method is proposed. The influence of inhomogeneous scattering shows much less effect in this case on the magnitude of the measured cross section than is the case when using the mass-spectrometric method. This method is described, the results of the measurements of the effective cross sections of double overcharge are given according to the new method, and the comparison of these data with

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30V/57-23-7-25/35

On the Method of Measuring the Effective Cross Sections of the Formation Processes of Negative Ions in Atomic Collisions

the data of the measurement of the equal cross sections by means of the mass-spectrometric method is carried out. The principle of the new method is explained by a concrete example. The apparatus described in detail in an earlier work (Ref 2) is used for the measurement of the cross sections of capture of two electrons by single-charged positive ions according to the method described. The ions H^+ in H_2 and Kr and the ions C^+, O^+ and Cl^+ in Kr, i.e. the cross sections of their double overcharge was measured, and the data obtained were compared to those results obtained by the mass-spectrometric method. The results of the measurements show that in the case of the investigated ion-molecule pairs forming due to double overcharge the negative ions are scattered through very small angles. The method described can be used without limitation for the measurement of cross sections expressed by the formula (1). It is suited for cross sections of the electron-loss processes only on the condition that the cross section of the loss of an electron is by far greater than the sum of the cross sections of the loss of two, three etc. electrons. There are 8 figures and 11 Soviet

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SOV/57-28-7-25/35

On the Method of Measuring the Effective Cross Sections of the Formation Processes of Negative Ions in Atomic Collisions

references.

ASSOCIATION: Fiziko-tekhnicheskiy institut AN USSR, Khar'kov
(Physico-technical Institute, AS Ukrainian SSR, Khar'kov)

SUBMITTED: October 11, 1957

Ions--Nuclear reactions

Card 3/3

SOV/56-34-3-8/55

AUTHORS: Fogel', Ya. M., Ankudinov, V. A., Pilipenko, D. V., Topolya, N. V.

TITLE: Electron Capture and -Loss in Collisions Between Fast Hydrogen Atoms and Gas Molecules (Zakhvat i poterya elektrona pri stolknoveniyakh bystrykh atomov vodoroda s molekulami gazov)

PERIODICAL: Zhurnal Eksperimental'noy i Teoreticheskoy Fiziki, 1958, Vol. 34, Nr 3, pp. 579-592 (USSR)

ABSTRACT: The authors determine by means of the mass-spectroscopic method the electron capture cross-section $\sigma_{0,-1}$ and σ_{01} and -loss in single collisions of hydrogen atoms (of an energy of up to from 5 to 40 keV) with helium-, neon-, argon-, crypton- and xenon atoms as well as with the molecules H_2, N_2 and O_2. The authors by σ_{ik} denote the cross section of a process in which a particle with the charge ie is transformed into a particle with the charge ke. The here worked out method makes possible besides the measurement of the cross sections σ_{0-1} and σ_{01} also the measurement of the cross section of the electron loss by an hydrogen atom, and therefore the present work also furnishes results of the measurement of this cross section.

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Electron Capture and -Loss in Collisions Between Fast Hydrogen Atoms and Gas Molecules

First the apparatus and the method of measurements are discussed in detail by means of a diagram. Two diagrams show the dependence of σ_{0-1} and σ_{01} on the energy of the hydrogen atoms for monoatomic and molecular gases. Within the investigated energy range the cross section σ_{0-1} for the hydrogen atoms in He, Ne, H_2, N_2 and O_2 passes through a maximum. In the gases A, Kr and Xe the cross section σ_{0-1} decreases monotonously with increasing energy. The cross section σ_{0-1} changes within the limits $2,4.10^{-18}cm^{-2}$ (in He, energy 5 keV) to $6,6.10^{-17}cm^2$ (in Xe, energy 5 keV). In molecular gases the amount of σ_{0-1} does not depend on the type of gas, this is, however, the case in monoatomic gases. This dependence is especially clear at low energies. σ_{0-1} increases with increasing atomic number of the inert gas. σ_{01} decreases in all gases with the exception of helium at a decrease of the energy of the hydrogen atoms. In helium σ_{01} has its maximum at an energy of 15 keV. σ_{01} changes within the limits $4,2.10^{-17}cm^2$ (in Kr, energy 5 keV) to $3,7.10^{-16}cm^2$ (Xe and N_2, energy 40 keV). The cross sections σ_{01} exceed by one order of magnitude the cross sections σ_{0-1}. Then the results found are compared with those of other authors. The presence of maxima in the curves

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SOV/56-34-3-8/55

Electron Capture and -Loss in Collisions Between Fast Hydrogen Atoms and Gas Molecules

$\sigma_{0-1} = f(E)$ in the gases He, Ne, H_2, N_2 and O_2 makes possible an estimation of the collision parameter for the corresponding processes. At table contains the values of the collision parameters which were computed by means of the adiabatic criterion by Massey (Messi). The dependence of the cross section σ_{0-1} on the binding energy of the electron can be expressed by the amount of the resonance defect $|\Delta E|$. The observed reduction σ_{0-1} at an increase of the absolute value of the resonance defect affirms the final conclusion on the reduction of this cross section with increasing energy of the binding of the electron in the atom of the target. There are 8 figures, 1 table, and 30 references, 8 of which are Soviet.

ASSOCIATION: Fiziko-tekhnicheskiy institut Akademii nauk Ukrainskoy SSR (Physical Technical Institut AS Ukrainian SSR)

SUBMITTED: September 30, 1957

Card 3/3

21(0)

AUTHORS: Fogel', Ya. M., Mitin, R. V., Kozlov, V. F., SOV/56-35-3-2/
Romashko, N. D.

TITLE: On the Applicability of Massey's Adiabatic Hypothesis to Double Charge Exchange Processes (O primenimosti adiabaticheskoy gipotezy Messi k protsessam dvoynoy perezaryadki)

PERIODICAL: Zhurnal eksperimental'noy i teoreticheskoy fiziki, 1958, Vol 35, Nr 3, pp 565 - 573 (USSR)

ABSTRACT: The present paper aims at analyzing the ion velocity dependence of the effective cross sections for double charge exchange of some types of ions in inert gases. The effective cross sections of the following processes were measured: $H_1^+ \rightarrow H_1^-$ in He, Ne, Ar, Kr, Xe, H_2, N_2 in the energy interval of 3-65 keV, further $C_1^+ \rightarrow C_1^-$ in Ar, Kr and Xe (50-65 keV), $O_1^+ - O_1^-$ in Ar and Kr (50-65 keV) $Cl_1^+ - Cl_1^-$ in Xe (50-60 keV) and $F_1^+ \rightarrow F_1^-$ in He, Ne, Ar, Kr, Xe and H_2 (5-50 keV). Figures 1-6 show the curves σ_{1-1} (v) for the various ions. Measurements were carried out

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On the Applicability of Massey's Adiabatic Hypothesis to Double Charge Exchange Processes SOV/56-35-3-8/4

according to the mass-spectroscopic method by means of a device which is described in detail (Ref 12). The measurements of cross sections σ_{1-1} for C_1^+, O_1^+, Cl_1^+ agree (within the error limits) with those of references 11 and 12, whereas those obtained for $H_1^+ \rightarrow H_1^-$ resulted in values that are lower by 1 1/2 to twice their amount than those of reference 9. It was found that the position of the maxima of the $\sigma_{1-1}(v)$-curves corresponds to Massey's adiabatic criterion. When carrying out such an analysis it is important to take into consideration the existence of excited ions in the primary beam as well as the formation of slow excited double-charged ions. Like in the case of the ordinary charge exchange the constant a in the double charge exchange depends slightly on the nature of the ion-molecule pair. (a = distance upon which the forces of interaction between the impinging particles act). The a-value for the double-charge exchange in inert gases (average: 1,5 Å) differs essentially from that in

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On the Applicability of Massey's Adiabatic Hypothesis to Double Charge Exchange Processes

SOV/56-35-3-2/6

molecular gases. According to equation (1) $a|\Delta E|/h\nu \approx 1$ the following is given (in Å) for a:

$H^+ - H_2$: 2,3; $O^+ - H_2$:0,9; F^+-H_2:0,9; H^+-N_2:2,0; Cl^+-N_2:0,5.

In conclusion the authors thank Professor A.K.Val'ter for the interest he displayed in this work. There are 7 figures, 3 tables, and 17 references, 6 of which are Soviet.

ASSOCIATION: Fiziko-tekhnicheskiy institut Akademii nauk Ukrainskoy SSR (Physico-Mathematical Institute of the Academy of Sciences, Ukrainskaya SSR)

SUBMITTED: March 15, 1958

Card 3/3

24(5)
AUTHORS: Fogel', Ya. M., Ankudinov, V. A., Pilipenko, D. V. SOV/56-35-4-5/52

TITLE: Electron Capture and -Loss in Collisions of Fast Carbon- and Oxygen Atoms With Gas Molecules (Zakhvat i poterya elektrona pri stolknoveniyakh bystrykh atomov ugleroda i kisloroda s molekulami gazov)

PERIODICAL: Zhurnal eksperimental'noy i teoreticheskoy fiziki, 1958, Vol 35, Nr 4, pp 868-874 (USSR)

ABSTRACT: In an earlier paper (Ref 1) the authors had already measured the effective electron capture and -loss cross sections for collisions between fast H-atoms and gas molecules. These measurements are repeated for C- and O-atoms. The primary energies of these atoms are between 10 and 65 keV; collisions between He, Ne, Ar, Kr and Xe atoms and the molecules H_2, N_2 and O_2 are investigated. Measurements of the energy of atoms was carried out with an accuracy of ±3%; the σ_{0-1}- and σ_{01}- values attained only ±15% (chance errors). The results obtained by these measurements are shown by diagrams. Figure 1 shows the

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electron capture cross section for C in noble gases; figure 2 shows the capture cross section for C in molecular gases; figure 3 shows the capture cross section for O in noble gases, and figure 4 the same in molecular gases. Figures 5 - 8 show the same for the loss cross sections. Figure 9 shows the electron capture cross sections σ_{0-1}, σ_{1-1}, and σ_{01} for C and O, and figure 10 the cross sections for the capture of an electron by O-, C-, and H-atoms in a comparative diagram, figure 13 shows the same for electron loss. Figure 11 shows the course of the dependence of the maximum σ_{0-1} on the energy of the electron affinity for Ar, Kr, and Xe. The curves show an exponential growth of $\sigma_{0-1\ max}$ with affinity. Figure 11 shows a non-monotonous decrease for increasing V_{ioniz} for the dependence of the maximum σ_{0-1} on the first ionization potential of the target atom. Figure 14, finally, shows that for the dependence of v_{max} on ΔE (ΔE - resonance effect) the measured values in individual gases scatter within the error limits

around Massey's (Messi) straight; it may therefore be said that Massey's adiabatic criterion for electron capture processes by fast atoms is valid. For a, a $\approx$3Å is obtained. Measurements of the capture- and loss cross sections (Figs 1-10) in dependence on the energy (velocity v) of the atoms in general show a more or less steep increase of the cross sections with v, and in some cases a marked maximum (e. g. the electron capture cross section for Xe and Kr at 40-50 keV) and a linear decrease for H in Xe. N. V. Topolya took part in these measurements. The authors thank Professor A. K. Val'ter for his interest in the work. There are 14 figures and 8 references, 4 of which are Soviet.

ASSOCIATION: Fiziko-tekhnicheskiy institut Akademii nauk Ukrainskoy SSR (Physico-Technical Institute of the Academy of Sciences of the UkrSSR)

SUBMITTED: April 8, 1958

24.6600

68197
SOV/58-59-5-11087

Translations from: Referativnyy Zhurnal Fizika, 1959, Nr 5, pp 167 - 168 (USSR)

AUTHORS: Fogel', Ya.M., Timofeyev, A.D.

TITLE: Double Charge-Exchange Involving Li^+ Ions in Single-Stage Collisions With Gas Molecules

PERIODICAL: Uch. zap. Khar'kovsk. un-t., 1958, Vol 98, Tr. fiz. otd. fiz.-matem. fak., Vol 7, pp 177 - 193

ABSTRACT: Using the mass-spectrographic method, the authors measured the effective cross sections of the double charge-exchange between 3 - 14 Kev Li^+ ions and H_2, N_2, O_2, He, Ne, Ar, Kr and Xe molecules. The effective cross sections of the double charge-exchange σ_{1-1} depend strongly on the kind of gas molecule and lie in the 10^{-21} - 10^{-19} cm^2 range. A comparison of the results of this study with the data on the double charge-exchange of H_1^+, C_1^+ and O_1^+ shows that the magnitude of σ_{1-1} decreases with an increase in the electron binding energy of the particle losing the electrons. The σ_{1-1} cross

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68197
SOV/58-59-5-11087

Double Charge-Exchange Involving Li^+ Ions in Single-Stage Collisions With Gas Molecules

section increases with an increase in the electron binding energy of the negative ion resulting from the exchange. The resonance defect is not a universal parameter determining the cross section of the double charge-exchange. The bibliography contains 14 titles.

4

Card 2/2

SOV/58-59-5-11088

Translation from: Referativnyy Zhurnal Fizika, 1959, Nr 5, p 168 (USSR)

AUTHORS: Fogel', Ya.M., Mitin, R.V.

TITLE: Double Charge-Exchange Involving Singly-Charged Cl^+ Ions in Single-Stage Collisions With Gas Molecules

PERIODICAL: Uch. zap. Khar-kovsk. un-t, 1958, Vol 98, Tr. fiz. otd. fiz.-matem. fak., Vol 7, pp 195 - 202

ABSTRACT: Using the mass-spectrographic method, the authors measured the effective cross sections of the double charge-exchange σ_{1-1} of 13 - 15 Kev Cl_1^+ ions in H_2, N_2, O_2, Ar, Kr and Xe. A comparison of the results with the data on the double charge-exchange of Li^+, C_1^+ and O_1^+ (of abs 11087) shows that the conclusions based on the analysis of the experimental data pertaining to the double charge-exchange of the latter ions are only partially borne out. The bibliography contains 9 titles.

Card 1/1

TO GEL', YA. M.

9(314) PHASE I BOOK EXPLOITATION SOV/2746

Akademiya nauk USSR. Fiziko-tekhnicheskiy institut

Elektrostaticheskiye generatory; sbornik statey (Electrostatic Generators; Collection of Articles) Moscow, Atomizdat, 1959. 255 p. 4,100 copies printed.

Ed. (Title page): A. K. Val'ter, Member, Academy of Sciences, USSR; Ed. (Inside book): Z. D. Andreyenko; Tech. Ed.: N. A. Vlasova.

PURPOSE: This collection of articles may be useful to scientists and engineers working with high-voltage electrostatic generators.

COVERAGE: The authors discuss the construction and operation of a number of electrostatic generators developed in the USSR and describe methods of generating negative hydrogen ions. They discuss the operation of accelerating tubes and present methods of stabilizing accelerator voltages. No personalities are mentioned. References appear at the end of some articles.

FOGEL', YA.M.

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24,2120

SOV/109-4-8-22/35

AUTHORS: Granovskiy, V.L., Luk'yanov, S.Yu., Spivak, G.V. and Sirotenko, I.G.

TITLE: Report on the Second All-Union Conference on Gas Electronics

PERIODICAL: Radiotekhnika i elektronika, 1959, Vol 4, Nr 8, pp 1339 - 1358 (USSR)

ABSTRACT: The conference was organised by the Ac.Sc.USSR, the Ministry of Higher Education and Moscow State University. It was opened by the chairman of the organising committee, M.A. Leontovich, Academician. During the plenary sessions of the conference, a number of survey papers were delivered. L.A. Artsimovich read a paper on "Production of Ultra-high Temperatures in Plasma".
A survey of the optical method of measurements was given in the papers by V.A. Fabrikant and S.E. Frish.
S. Brown of the Massachusetts Institute of Technology gave a survey of the high-frequency methods of the investigation of stationary and non-stationary plasma (see p 1244 in this issue of the journal).
N.V. Fedorenko read a paper entitled "Ionisation and Inelastic Scattering During Atomic Collisions".

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L.A. Sena and Yu.M. Kagan deal with "Elementary Processes of Determining the Motion of Ions in Gas".
A paper by Ye. Bedereu (Rumania) dealt with "The Role of Resonance--recharging in the Kinetics of Ions".
I.S. Stakol'nikov considered the initial stages of the development of sparks (corona-leader, main channel and the final channel).
B.N. Klyarfel'd gave a survey of the ignition processes of the discharges in highly rarified gases.
The mechanism of the breakdown of a high-vacuum gap was elucidated in a paper by V.L. Granovskiy.
L. Tonks (USA) expounded a theory of the motion of electrons in a magnetic trap (see p 1316 of this journal).
Academician R. Rompe (Eastern Germany) described a number of experiments on non-stationary plasma conducted by himself.
M. Stenbeck (Eastern Germany) gave a generalised theory of plasma. The conference was divided into six sections.
The first section was presided over by L.A. Sena and was concerned with the elementary processes in gas discharges.
The following papers were read in this section:
Ya.M. Fogel' - "Transformation of Positive Ions Into Negative Ones in Rarified Gases".
Ya. M. Fogel' with V.A. Ankudinov and D.V. Pilipenko - "Capture and Loss of Electrons During the Collision of Fast Atoms of Carbon and Hydrogen with the Molecules of Gases".
N.V. Fedorenko et al. - "Dissociation of Molecular Ions of Hydrogen During Collisions in Gas".
I.P. Flaks and Ye.S. Solov'yev - "Capture Cross-sections of Electrons in Multicharge Ions in Inert Gases".
R.M. Kushnir et al. - "Experimental Investigation of the Resonance Recharging in Certain Single-atom Gases and Metal Vapours".
O.B. Firsov - "Qualitative Investigation of Inelastic Collisions of Atoms".
L.M. Volkova - "Effective Excitation Cross-sections of the Spectral Lines of Potassium and Argon".

Card3/15

I.P. Zapesochnyy and S.M. Kishko "Some Results of the Investigation of the Optical Functions of the Excitation Bands of a Negative System".
A.A. Vorob'yev and A.G. Vlasov - "Investigation of the Scattering of the Electrons In a Betatron Chamber".
The second section was presided over by B.N. Klyarfel'd and was devoted to the problems of the electrical breakdown in rarified gases and in high vacuum. The following papers were read in this section:
G.Ya. Makar-Limanov and Yu.A. Metlitskiy.- "Electrostatic Control of the Ignition of Glow-discharge Tubes"(see p 1274 of the journal).
S.V. Ptitsyn et al. were concerned with the breakdown in a high-voltage mercury rectifier (see p 1278 of the journal).
L.G. Guseva "Ignition of the Discharge in Non-uniform Fields at low Gas Pressures" (see p 1260 of the journal).
A.S. Soboleva and B.N. Klyarfel'd - "The Discharge Phenomena Between a Point and a Plane at Gas Pressures of 10^{-3} - 1 mm Hg".

35339
S/194/62/000/001/044/066
D201/D305

26.2312

AUTHORS: Koval', A. G., Krupnik, L. I., Timofeyev, A. D. and Fogel', Ya. M.

TITLE: Obtaining a beam of negative hydrogen ions by reversing the charge polarity of the positive ions in the cathode channel of a high frequency source

PERIODICAL: Referativnyy zhurnal, Avtomatika i radioelektronika, no. 1, 1962, 56, abstract 1Zh391 (V sb. Elektrostat. generatory, M., Atomizdat, 1959, 15-22)

TEXT: The latest data on effective capture cross-sections and electron losses by hydrogen particles in their collisions with hydrogen molecules (RZhFiz, 1955, no. 7, 13596; 1957, no. 5, 12345; 1958, no. 1, 701; no. 11, 24892; 1959, no. 11, 25520) are used to determine the optimum conditions for the operation of negative hydrogen ion source as suggested by Phillips and Tuck (RZh Fiz, 1959, no. 11, 32135). In this source, the beam of negative ions is obtained by changing the charge polarity of positive ions

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Obtaining a beam ...

in a gas flowing in the cathode channel of a HF source. The graphs of calculated ratios I^+/I_o^+ and I^-/I_o^+ as functions of the target thickness are given for the ion energies of 4 and 6 keV (here I_o^+ - the current of positive ions entering the channel of the HF source and I^+ and I^- - the currents of positive and negative ions respectively, in the beam which has left the channel). The graphs of dependence of I^-, I^+ and I_o^+ on the gas stream flowing into the source container are also given. Calculations show that the investigated method of obtaining negative hydrogen ions cannot produce high intensity beams. Nevertheless, in cases when a current of H_1^- ions of the order of 10 μA is sufficient, the use of the above method may be recommended. 11 references. [Abstracter's note: Complete translation.]

Card 2/2

S/194/62/000/001/045/066
D201/D305

AUTHORS: Fogel', Ya. M., Slabospitskiy, R. P. and Guzhovskiy, I. T.

TITLE: Formation of negative ions of helium, carbon, oxygen and chlorine in passing of positive ions through an ultrasonic stream of mercury vapor

PERIODICAL: Referativnyy zhurnal, Avtomatika i radioelektronika, no. 1, 1962, 62, abstract 1Zh437 (V sb. Elektrostat. generatory, M., Atomizdat, 1959, 32-45)

TEXT: The transformation of positive He, C_2, O_2 and Cl ions into negative ions in their passing through a mercury vapor target is investigated and the possibility of obtaining a source of heavy negative ions for the charge-change generator is explained. An HF-source was used for obtaining a beam of positive ions. The sorting of ions according to their energy was achieved by means of the electric field of a plane condenser, placed in front of the input to a magnetic analyzer. The results of investigation into the de-

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pendence of the transformation coefficient on the energy of primary beam and the temperature of the heater determining the beam thickness are given. The current distribution and its cross-sectional density are given for a beam of negative ions, as obtained by means of a Faraday cylinder, with a variable diaphragm placed at the input of the magn. analyzer. [Abstracter's note: Complete translation.]

Card 2/2

30605
S/058/61/000/008/005/044
A058/A101

26.2351

AUTHORS: Fogel', Ya. M., Krupnik, L. I., Koval', A. G., Timofeyev, A. D.

TITLE: A source of hydrogen anions for a recharging electrostatic generator

PERIODICAL: Referativnyy zhurnal, Fizika, no. 8, 1961, 34, abstract 8B26 (V sb. "Elektrostat. generatory". M., Atomizdat, 1959, 141-182)

TEXT: The authors describe three models of a hydrogen anion source based on the effect of transformation of hydrogen cations into anions incident to passage through a supersonic stream of mercury vapors. It became clear from experiments that in order to obtain maximum current it was advantageous to employ $H_3^+ \rightarrow H_1^-$ and $H_2^+ \rightarrow H_1^-$ transformations rather than the $H_1^+ \rightarrow H_1^-$ transformation. It is shown that the transformation coefficient in a mercury vapor target is greater than in an oil vapor target. The third source model made it possible to generate a H_1^- ion current of $\simeq 20 \mu a$.

D. Koshkarev

[Abstracter's note: Complete translation]

Card 1/1

21(0)

AUTHORS: Fogel', Ya. M., Kozlov, V. F., Kalmykov, A. A., Muratov, V. I.

SOV/56-36-4-55/70

TITLE: Direct Proof of the Applicability of the Adiabatic Criterion of Massey for Processes With Double Charge Exchange (Pryamoye dokazatel'stvo primenimosti adiabaticheskogo kriteriya Messi k protsessam dvoynoy perezaryadki)

PERIODICAL: Zhurnal eksperimental'noy i teoreticheskoy fiziki, 1959, Vol 36, Nr 4, pp 1312-1314 (USSR)

ABSTRACT: As shown in a previous paper (Ref 1), the investigation of the rate dependence of the cross sections of the double re-charge of the ions H^+ and F^- leads to the result that the curves $\sigma_{1-1}(v)$ have two maxima for these ions. This fact is dealt with according to Massey's adiabatic criterion; thus, a maximum of such an inelastic process with a resonance defect ΔE must be observable if $a|\Delta E|/h\nu_{max} \approx 1$. The occurrence of two maxima in the curves $\sigma_{1-1}(v)$ for the processes $H^+ \rightarrow H^-$ and $F^- \rightarrow F^-$ can be explained either by the formation of slow excited doubly-charged ions (at $H^+ \rightarrow H^-$) or by the existence of impurity ions in excited metastable states in the primary

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beam (at $F^+ \rightarrow F^-$). The two maxima indicate that besides the process $F^+ \rightarrow F^-$ also the process $F^{+*} \rightarrow F^-$ develops, viz. with a different resonance defect but with the same a-value. For the purpose of clarifying these conditions the authors investigated the processes $B^+ \rightarrow B^-$ in Xe, Kr, and H_2 and $O^+ \rightarrow O^-$ in Xe. In the former case the curve $\sigma_{1-1}(v)$ had 3 maxima, in the latter it had two. Results:

Process	Excitation energy [ev] (calculated)	ion term		term energy [ev]
$B^+ - Kr$	5.6 ± 1.6	$2s2p$	$^3P^0$	4.6
$B^+ - Kr$	11.7 ± 1.6	$2p^2$	^3P	12.1
$B^+ - Xe$	5.0 ± 0.9	$2s2p$	$^3P^0$	4.6
$B^+ - Xe$	11.3 ± 1.0	$2p^2$	^3P	12.1

Direct Proof of the Applicability of the Adiabatic Criterion of Massey for Processes With Double Charge Exchange

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Process	Excitation energy [ev] (calculated)	ion term	term energy [ev]
$B^+ - H_2$	4.4 ± 0.3	$2s2p\ ^3P^0$	4.6
$B^+ - H_2$	11.0 ± 2.0	$2p^2\ ^3P$	12.1
$O^+ - Xe$	24.2 ± 0.5	$2s2p^4\ ^2S$	24.4

The results obtained are discussed in detail. For $Li^+ \rightarrow Kr$, $Li^+ \rightarrow H_2$, and $Li^+ \rightarrow Ar$ the curves $\sigma_{1-1}(v)$ are given in form of diagrams. The additional maxima are where they must be according to Massey's criterion. Herefrom follows the identity of the a-values for processes of double re-charge of uncharged and charged ions. The results obtained by the investigation of the process $Li^+ \rightarrow Li^-$ provide direct proof of the applicability of Massey's criterion to such ions and also prove the correctness of the explanation of the nature of additional maxima of the curves $\sigma_{1-1}(v)$ in the processes investigated.

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Direct Proof of the Applicability of the Adiabatic Criterion of Massey for Processes With Double Charge Exchange

SOV/56-36-4-55/70

There are 1 figure, 1 table, and 3 references, 2 of which are Soviet.

ASSOCIATION: Fiziko-tekhnicheskiy institut Akademii nauk Ukrainskoy SSR (Physico-technical Institute of the Academy of Sciences, Ukrainskaya SSR). Khar'kovskiy gosudarstvennyy universitet (Khar'kov State University)

SUBMITTED: December 20, 1958

Card 4/4

21(1)

AUTHORS: Fogel', Ya. M., Kozlov, V. F. Kalmykov, A. A.

SOV/56-36-5-4/76

TITLE: On the Problem of the Existence of the Negative Nitrogen Ion (K voprosu o sushchestvovanii otritsatel'nogo iona azota)

PERIODICAL: Zhurnal eksperimental'noy i teoreticheskoy fiziki, 1959, Vol 36, Nr 4, pp 1354-1356 (USSR)

ABSTRACT: The authors of the present paper as well as Dukel'skiy and his collaborators have already investigated this problem and published a number of papers (Refs 1 - 5, 8 - 11) dealing with this subject. The results obtained by these investigations are first discussed. For the investigations, the results of which are discussed by the present paper, a mass-spectrometrical device, which is described by reference 13, was used. An N^+ beam of 34 kev coming from a high frequency ion source was led into the collision chamber, which was filled with krypton. A number of peaks was observed in the mass spectrum of the beam, of which the following were observed in the region of the peak corresponding to the mass 14: 12(C_{12}^+),

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$13(C^+_{13} + C_{12}H^+)$, $15(N^+_{15} + N_{14}H^+)$, $16(O^+_{16} + C_{12}H^+_4 + N_{14}H^+_2)$, $17(O_{16}H^+ + N_{14}H^+_3)$ and $18(O_{16}H^+_2)$. The resolving power of the mass monochromator sufficed for the purpose of clearly separating the peak with the mass 14 from the neighboring peaks. Analysis of the beam was carried out by means of a magnetic analyzer. Measurement of the current of the negative ions was carried out by means of a tube electrometer having a sensitivity of 10^{-14} a/division mark. Already the first experiment carried out with an ion beam (m=14) and an amperage of 10^{-7} a showed that in the beam penetrating the collision chamber there were some N^--ions with m=14. By the mass-spectrometer method a cross section for the formation of an N^--ion during passage of an N^+ through a gas target of $3.2.10^{-22}$ cm^2 was determined. Consideration of σ^{14}_{1-1} finally resulted for the process $N^+ \rightarrow N^-$ in a cross

section value of $1.9.10^{-22} cm^2$. The experiments carried out with H_2O^+ and the processes $CH_2^+ \rightarrow CH_2^-$ and $NH^+ \rightarrow NH^-$ at an energy of the positive ions of 34 kev in krypton are described. For the two last-mentioned processes cross sections of $5.3.10^{-19}$ and $5.3.10^{-18}$ cm^2 are obtained. The question was further investigated as to whether N_2^+-ions occurred, but none were found, i. e. the cross section of the process $N_2^+ \rightarrow N_2^-$ should be smaller than $1.5.10^{-22} cm^2$. There are 17 references, 10 of which are Soviet.

ASSOCIATION: Fiziko-tekhnicheskiy institut Akademii nauk Ukrainskoy SSR (Physico-Technical Institute of the Academy of Sciences, Ukrainskaya SSR)

SUBMITTED: November 15, 1958

24.2120,24.6000,24.7400

77331
SOV/57-30-1-10/18

AUTHORS: Fogel', Ya. M., Slabospitskiy, R. P., Rasrepin, A. B.

TITLE: Charged Particle Emission From Metal Surfaces During Positive Ion Bombardment

PERIODICAL: Zhurnal tekhnicheskoy fiziki, 1960, Vol 30, Nr 1, pp 63-73 (USSR)

ABSTRACT: Introduction: In previous work of this kind researchers were able to measure only the sum of the K^- coefficient of secondary negative ion emission and R, the coefficient of reflection of incoming ions. In the 10 kev incoming proton energy region one cannot give any reasonable meaning to K^- due to a steep rise in R. To date there are no data about K^+, the coefficient of secondary positive ion emission, in scientific literature. In the present investigation the authors measured K^- and K^+ coefficients for Mo bombarded by

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H^+, He^+, Ne^+, Ar^+, Kr^+, and O^+, and for Ta, W, Cu, and Fe bombarded by H^+, Ne^+, and Ar^+. Incoming ion energy varied between 10 and 40 kev. The method also allowed the measurements of the coefficient γ of the secondary electron emission, and of R.. The authors report these values in this paper, too. Description of the experimental set-up: Figure 2 represents the diagram of the experimental set-up. The ion gun consists of a high-frequency ion source 1, a symmetrical three-electrode lens 2, and an accelerating tube 3. Two crossed plate condensers 4, adjust the direction of the beam, and the Faraday cage 5, measures the ion yield of the gun. Next, the ions go through the mercury vapor target 6, used to generate negative hydrogen ions by a method described by Fogel' and others (ZhTF, XXVI, 1208, 1956). Negative hydrogen ions are used to compare the coeffipients of secondary ion emission due to positive and negative ions of the same material. The magnetic lens 7, supplies an additional focusing while the mass-monochromator 8,

Charged Particle Emission From Metal Surfaces During Positive Ion Bombardment

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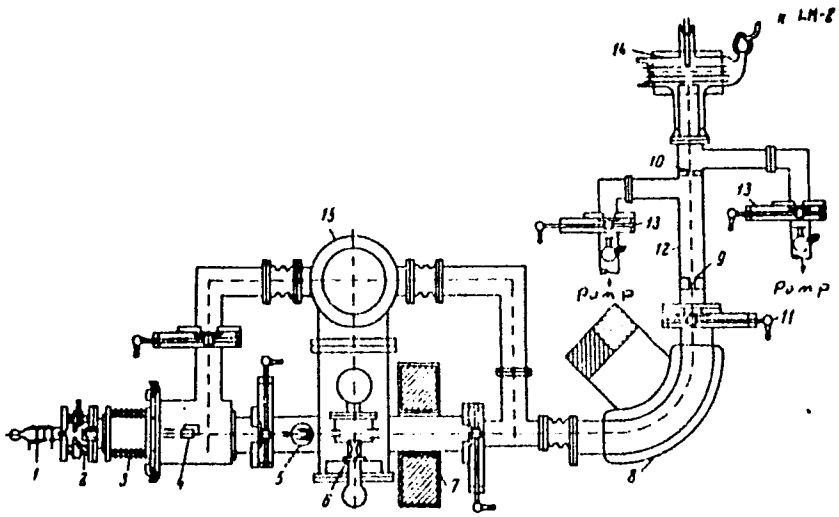

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Fig. 2.

supplies monoenergetic ions of unique mass. Channels 9 and 10 (2 × 4 × 20, and 2 × 4 × 9 mm, respectively) at a mutual distance of 370 mm, constitute the collimator 12, leading to the measuring chamber 14, represented on Fig. 3.

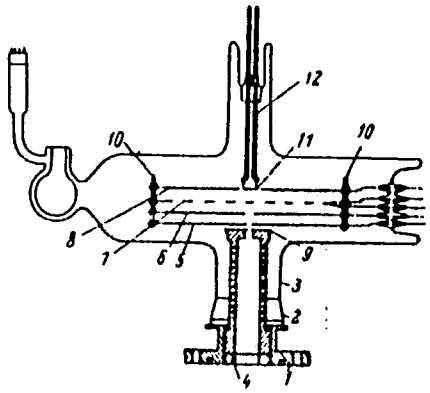

Fig. 3.

The glass container 3, houses the screen 5, preventing the scattered incoming ions from reaching the collector 6, the grid 7, the target screen 8, and the target 11. The glass is soldered to a fernico ring 2, which is soldered further to the metallic flange 1, connected to the collimator. All electrodes, except the target, are mounted on two quartz plates 10, representing a frame fixed inside the container walls. Target consists of a metal strip 0.1 mm thick, mounted on two molybdenum leads 5 mm in diameter. A magnetic screen 4, of iron shields the incoming ion beam. Transparency of the grid equals 97%. Target with screen, grid, collector, and screen are separated 10 mm from one another. The chamber is inside a magnetic field of approximately 500 Oersteds, parallel to the planes of the electrodes. The whole assembly is evacuated by means of the MM-1000 diffusion pump 15, while additional pumping of the collimator and measuring chamber is done by means of two MM-40 diffusion pumps. During the measurements the pressure in the chamber was kept

at 2 to 3 · 10^{-7} mm Hg. Incoming beam current was usually of the order of 10^{-9} amp. Currents of the secondary and reflected ions on the collector were measured using a string electrometer with a sensitivity of 6.7 · 10^{-12} amp/div. Methods of measurements: Consider the relation between the collector current I_c and the potential difference $V_{t.g.}$ between the target and the grid for a constant potential $V_{g.c.}$ between the grid and collector, accelerating positive ions from the grid toward the collector. For some value of $V_{t.g.}$ the collector collects all secondary and reflected primary ions. If $E^-_{o\ max} < e(V_{g.c.} + V_{t.c.})$, where $E^-_{o\ max}$ is the maximum initial energy of the secondary ions, they cannot reach the collector, and, therefore, $I'_c = I^+_{sec} + I^+_{refl}$. Changing the sign of $V_{t.g.}$ one slows the secondary ions down, and accelerates the negative ions. Reflected ions always reach

the collector since the primary beam has 10 kev or more of energy. In a like manner, changing electrode potentials the authors define $I''_c = I^+_{refl}$; $I''_c = I^-_{sec} - I^+_{refl}$. The curve $I_c = f(V_{t.g.})$ at constant $V_{g.c.}$ must have three plateau regions as seen in Fig. 1.

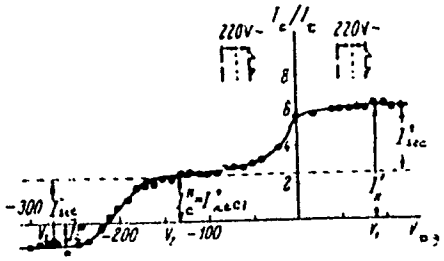

Fig. 1.

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The coefficients are then given by

$$K^- = \frac{I_c'' + I_c'''}{I_t + I_c'' - I_c'''}, \qquad (1)$$

$$K^+ = \frac{I_c' - I_c''}{I_t + I_c''}, \qquad (2)$$

$$R = \frac{I_c''}{I_t + I_c''}. \qquad (3)$$

where I_t denotes the target current. Similarly, the authors obtain the coefficient γ, taking into account the effects of the magnetic field. This field is in general used to prevent secondary electrons from reaching the collector. Results of measurements: Targets are always prepared in the same

way to eliminate the influence of surface variations. They are etched first in diluted sulfuric acid, then washed in distilled water and dried in an oven; next, they are heated in a 2 to 3 $\cdot 10^{-7}$ mm Hg vacuum up to 2000° C for Mo, Ta, and W; and up to 900° C for Cu and Fe during 30 to 40 min; finally, they are bombarded with the ion beam for one hour. After such a treatment the coefficients stay constant over a whole working day (6 to 8 hours) and are fully reproducible. Results of the measurements of coefficients for a number of ions are on Fig. 4. The results of comparison of coefficients during an H^+ and H^- bombardment of the same M_o surface are given in Table A. Ion energy was 22 kev. The authors assume that the K^- variation is due to the $H^- \longrightarrow H^+$ conversion of the incoming hydrogen ion on the surface. The γ coefficient

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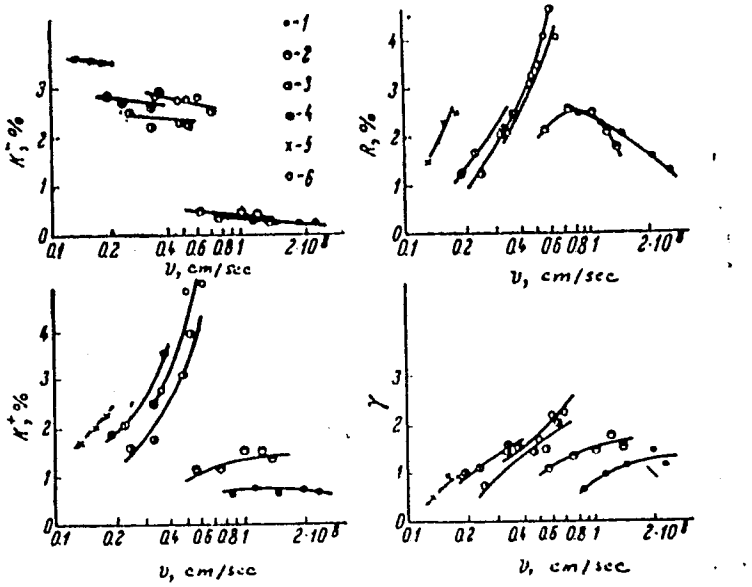

Fig. 4. (1) H^+; (2) He^+; (3) Ne^+; (4) Ar^+; (5) Kr^+; (6) O^+.

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Charged Particle Emission From Metal Surfaces During Postive Ion Bombardment

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Table A

Coefficient \ Ion	H^-	H^+
K^-, %	1.14	0.71
K^+, %	0.45	0.44
R, %	2.03	1.56
γ	3.52	1.38

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variation has been observed already by Zandberg (ZhTF, XXV, 1386, 1955) and Dukel'ckiy (ZhTF, 19, 731, 1949). To investigate the influence of adsorbed gases the authors kept a M_o target at 1800° C for 20 minutes and measured the values of coefficients as function of time. Results are on Fig. 5. The beam consisted of 12 kev Ar^+ ions. The authors explain the curves by assuming that the removal of the adsorbed gas by baking reduces to zero the emission of secondary ions. Since, according to Hagstrum (see references) it takes only a few seconds at 10^{-7} mm Hg to build a monomolecular layer on an outgased sample, and it took some 20 minutes to bring the K^- and K^+ coefficients to their original values, the authors concluded that many layers of adsorbed gas must be responsible for the secondary emission. The γ coefficient behavior is in agreement with results of Waters (see references)

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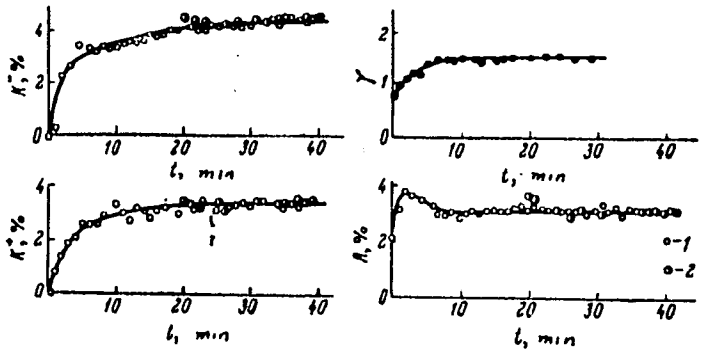
Fig. 5. (1) beam sent on the target 30 seconds after the end of heating; (2) beam sent on the target 20 minutes after the end of heating.



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and Brunnee (Zs. f. Phys., 147, 161, 1957). The authors investigated the influence of the target temperatures on the coefficients. Although they found regular temperature variations due probably to different thickness of adsorbed gas layers, the process did not lead to the same values during the heating and then cooling-back, and the authors have no explanation for these effects. Hydrogen, at approximately 10^{-4} mm Hg was also brought in contact with the target at 1500° C, to investigate the influence of the nature of adsorbed gas on the coefficients. Figure 7 shows distinct changes in their values. The target metals had considerable influence on the coefficients, as seen on Fig. 8. The authors will perform a more detailed evaluation of the present data after performing the next stage of planned experiments which include the investigation of the composition of the secondary ionic emission by means of a mass spectrometer, the determination of their energy spectrum, and the

influence of the outgasing process and target temperature on each type of ions, separately. Professor A. K. Val'ter showed interest in this work. There are 8 figures; and 17 references, 8 Soviet, 1 German, 4 U.K., 4 U.S. The most recent U.K. and U.S. references are: R. C. Bradley, J. Appl. Phys., 30, 1 (1959); P. M. Waters, Phys. Rev., 111, 1053 (1958); R. E. Honig, J. Appl. Phys., 29, 549 (1958); H. D. Hangstrum, Rev. Sci. Insr., 24, 1122 (1953); F. L. Arnot, C. Becket, Proc. Roy. Soc., A168, 103 (1938).

ASSOCIATION: Khar'kov State University imeni A. M. Gor'kiy (Khar'kovskiy gosudarstvennyy universitet imeni A. M. Gor'kogo)

SUBMITTED: June 15, 1959

Charged Particle Emission From Metal Surfaces During Positive Ion Bombardment

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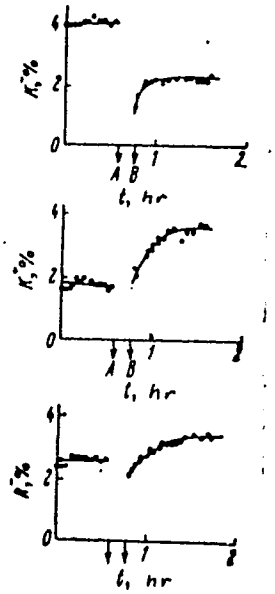
SOV/57-30-1-10/18

Fig. 7. (A) Start of t the target heating; (B) end of the target heating.



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Charged Particle Emission From Metal Surfaces During Positive Ion Bombardment

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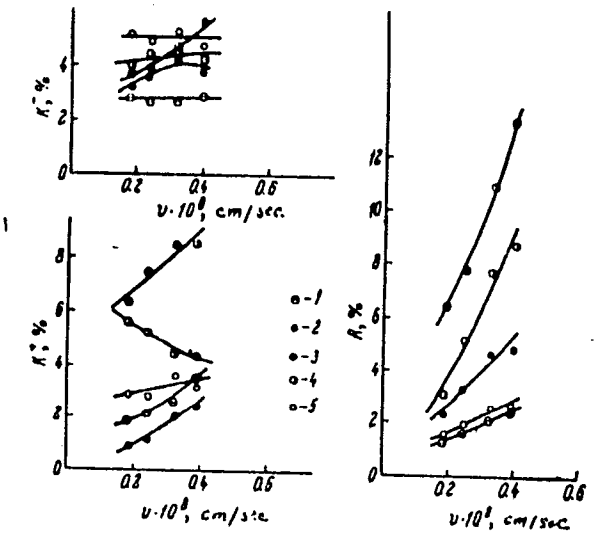

Fig. 8. Ions Ar^+.
(1) Mo; (2) Fe;
(3) Ta; (4) W;
(5) Cu.

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FOGEL', Ya.M., SLABOSPITSKIY, R.P., KARNAUKHOV, I.M.

Mass-spectrometric investigation of the secondary positive and negative ion emission, arising in the bombardment of the surface of Mo by positive ions. Zhur. tekh. fiz. 30 no.7:824-834 Jl '60. (MIRA 13:8)

1. Khar'kovskiy gosudarstvennyy universitet im. A.M. Gor'kogo.
(Molybdenum) (Mass spectrometry) (Ions)

FOGEL', Ya.M.; ANKUDINOV, V.A.; PILIPENKO, D.V.

Capture and loss of electrons in collisions of fast He, B, and F atoms with gas molecules. Zhur. eksp. i teor. fiz. 38 no.1: 26-32 Jan '60. (MIRA 14:9)
(Electrons--Capture) (Collisions (Nuclear physics))

83714
S/056/60/038/004/007/048
B019/B070

9,9130
24,2120

AUTHORS: Fogel', Ya. M., Koval', A. G., Levchenko, Yu. Z.

TITLE: Ionization of Gases by Negative Ions

PERIODICAL: Zhurnal eksperimental'noy i teoreticheskoy fiziki, 1960, Vol. 38, No. 4, pp. 1053-1060

TEXT: The authors have determined the total production cross sections of positive ions for the collision of H^--ions of energies 10-50 kev with He-, Ne-, Ar-, Kr-, and Xe atoms and H_2-, N_2-, and O_2 molecules; and for the collision of O^- ions of energies 10-50 kev with atoms of inert gases and H_2- and O_2 molecules. The source of the negative ions was the injector (Fig. 1) of the charge exchange electrostatic accelerator which is being constructed at FTI AN USSR (Institute of Physics and Technology of the AS UkrSSR). Some of the extensive experimental material is reproduced diagrammatically in Figs. 2, 3, and 4. It is concluded from a discussion of the results that H^+-, H^--, and D^- particles have almost the same ionization cross section inspite of differences in the charge, mass, and

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Ionization of Gases by Negative Ions

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the structure of the electron shells. The difference between the cross sections of H^-- and O^- ions in the energy range investigated is explained as being due to the lower velocity of the O^- ions in that range. It is concluded further that for equal velocities O^- has a larger production cross section for positive ions than H^- has. This is in agreement with the hypothesis according to which the cross section of the transition of electrons in the state of continuous spectrum increases with the increase in the number of electrons in the electron shells of the colliding particles. An investigation of the charge spectrum of slow ions, and the determination of ionization cross section with removal of one, two, and three electrons is briefly mentioned. N. V. Fedorenko is mentioned. Professor A. K. Val'ter is thanked for his constant interest; L.P. Rekova and A. F. Khodyachikh for collaboration in measurements; and P.A. Chudnyy, the mechanic, for setting up the collision chamber. There are 4 figures and 20 references: 10 Soviet, 5 US, and 2 British.

ASSOCIATION: Fiziko-tekhnicheskiy institut Akademii nauk Ukrainskoy SSR (Institute of Physics and Technology of the Academy of Sciences, UkrSSR)

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83714

Ionization of Gases by Negative Ions

S/056/60/038/004/007/048
B019/B070

SUBMITTED: September 29, 1959

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83759

S/056/60/039/003/004/045
B004/B060

26.1420

AUTHORS: Fogel', Ya. M., Koval', A. G., Levchenko, Yu. Z., Khodyachikh, A. F.

TITLE: Composition of the Slow Ions Arising on the Ionization of Gases by Means of Negative Ions

PERIODICAL: Zhurnal eksperimental'noy i teoreticheskoy fiziki, 1960, Vol. 39, No. 3 (9), pp. 548-555

TEXT: By way of introduction, the authors discuss the difference existing between ionization by means of positive ions and ionization by negative ions, and then report on their measurements of the ionization cross section of He, Ne, Ar, Kr, X, H_2, N_2, and O_2 by means of H^- and O^- ions with a 10 - 50 kev energy. The analyzer of the charges of slow ions is described in great detail (Fig. 1). The analysis was made by means of a magnetic mass spectrometer with a field strength of 6000 oersteds. The current on the beam catcher was measured by means of an ЭМУ-3 (EMU-3) tube electrometer. Experiments were carried out at $(1-1.5)\cdot10^{-4}$ torr.

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Composition of the Slow Ions Arising on the Ionization of Gases by Means of Negative Ions

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The ionization cross section σ^i_{On} in the removal of n electrons was calculated by the equation: $\sigma^i_{On} = \alpha_n \sigma^+/n$; α_n and σ^+ were measured (1). α_n is the relative intensity of the spectral line corresponding to the n-foldly charged ion; σ^+ is equal to $\sum_{n=1}^{Z} n\sigma^i_{On}$.

Figs. 2-6 show σ^i_{On} for X, Kr, Ar, and Ne, Figs. 8-10 for H_2, O_2 and N_2 as a function of the velocity v of H^- and O^- ions. With increasing multiplicity of ionization, i.e. with increasing sum of the ionization potentials, $(\sigma^i_{On})_{max}$ drops rapidly (Fig. 7). The following results are given: 1) At equal velocity of the initial ions, the ionization cross section is larger for O^- ions than for H^- ions both in molecular and in atomic gases. 2) Both in atomic and molecular gases, the cross section increases with rising atomic number. 3) With the exception of the pair $O^- - O_2$, the cross section of the formation of singly-charged molecular ions is larger than the cross section of singly-charged atomic ions.

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Composition of the Slow Ions Arising on the Ionization of Gases by Means of Negative Ions

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B004/B060

The cross section for the formation of doubly-charged ions is considerably smaller than that for singly-charged ions. 4) The cross section of the formation of singly-charged molecular ions is little dependent on the type of gas, while the cross section for the formation of H^+ is considerably smaller than that for N^+ and O^+. In Figs. 4 (Ar), 8 (H_2), 9 (N_2), 10 (O_2), the cross sections of the formation of slow ions by H^- are compared with the cross sections of ionization by protons indicated in Ref. 5. Fig. 11 gives a comparison of the cross section of ionization of H_2 by H atoms with that by H^- ions. The effect of the excess electron in H^- on the ionization of the H_2 molecule is but slight. The authors thank Professor N. V. Fedorenko and V. V. Afrosimov for their advice, and Professor A. K. Val'ter for interest displayed in the work. There are 11 figures and 8 references: 7 Soviet and 1 German.

ASSOCIATION: Fiziko-tekhnicheskiy institut AN Ukrainskoy SSR (Institute of Physics and Technology of the AS of the Ukrainskaya SSR)

SUBMITTED: April 9, 1960

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86888

S/056/60/039/005/002/051
B029/B077

26.2312

AUTHORS: Fogel', Ya. M., Kozlov, V. F., Polyakova, G. N.

TITLE: A Twofold Charge Exchange of Ions of Alkali Metals

PERIODICAL: Zhurnal eksperimental'noy i teoreticheskoy fiziki, 1960, Vol. 39, No. 5(11), pp. 1186 - 1192

TEXT: The present article presents new experimental data on the twofold charge exchange of Li^+, Na^+, and K^+ ions in several gases. These data show that Massey's adiabatic criterion can be used to find the type of relation between the exchange cross section σ_{1-1} and the velocity of the primary ions in a velocity range $v < v_{max}$. The authors determined the cross section σ_{1-1} for the process $Li^+ \rightarrow Li^-$ in H_2, Ar, Kr, and Xe in the energy interval of 5-60 kev, for the process $Na^+ \rightarrow Na^-$ in H_2, Ar, Kr, Xe in the energy interval of 10-55 kev, and for $K^+ \rightarrow K^-$ in H_2, Ne, Ar, Kr, Xe in the interval of 10-80 kev. The form of the curves

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$\sigma_{1-1}(v)$ depends upon the type of ion source that generates the primary-ion beam. The complicated structure of these curves can be explained by the addition of ions in excited, metastable states to the primary ion beam. Therefore, not only $A^+ + B \rightarrow A^- + B^{++}$ processes can take place but also $A^{+*} + B \rightarrow A^- + B^{++}$ (twofold charge exchange of excited fast ions) and $A^{+*} + B \rightarrow A^- + B^{++*}$ processes (twofold charge exchange of excited fast ions accompanied by the production of excited slow ions). The forms of the curves $\sigma_{1-1}(v)$ for the charge exchange $K^+ \rightarrow K^-$ with beams of a thermionic and a high-frequency source are similar, that is, the maxima of these two curves are located at the same velocities. Only the heights of these maxima are different due to a different concentration of excited ions in the beam. The curves representing the charge exchange for the various types of ions are described in detail with the aid of four diagrams. The form of the curves $\sigma_{1-1}(v)$ for the processes $Na^+ \rightarrow Na^-$ and $K^+ \rightarrow K^-$, like that of the previously investigated processes $H^+ \rightarrow H^-$, $Li^+ \rightarrow Li^-$, $B^+ \rightarrow B^-$, $O^+ \rightarrow O^-$, and $F^+ \rightarrow F^-$, can be fully explained by the adiabatic criterion $a|\Delta E|/hv_{max} \approx 1$. a denotes

the distance where the interaction forces act between colliding particles; (G. F. Drukarev gave another explanation for a), and ΔE represents the so-called resonance defect, i.e., the change of intrinsic energy of the particles due to the process considered. During the $K^+ \rightarrow K^-$ process, for instance, the additional maximum is much larger than the principal maximum since $\sigma_{1-1\max}$ decreases rapidly with increasing resonance effect in this case. The form of the curve $\sigma_{1-1}(v)$ follows the formula $\sigma = \sigma_o \exp\{- ka|\Delta E|/hv\}$ only in that section of the curve where the condition $a|\Delta E|/hv \gg 1$ is not satisfied. This also holds for the processes $A^+ + B \rightarrow A^- + B^{++}$ and $A + B \rightarrow A^- + B^+$. At the conference on Electron and Atom Collisions (Riga, June 1959) V. M. Dukel'skiy stated that the deviation from Massey's adiabatic criterion is due to the fact that the relative velocity of the particles is not the same before and during the collision. An investigation of the functions $\sigma(v)$ for different processes at low velocities is considered necessary. The authors thank Professor A. K. Val'ter for his interest, and V. I. Muratov and O. I. Yekhichev for assisting in

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measurements. There are 4 figures and 15 references: 12 Soviet, 1 US, and 2 British.

ASSOCIATION: Kar'kovskiy gosudarstvennyy universitet (Khar'kov State University). Krymskaya astrofizicheskaya observatoriya Akademii nauk SSSR (Crimean Astrophysical Observatory of the Academy of Sciences USSR)

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AUTHOR: Fogel', Ya. M.

TITLE: Production of Negative Ions in Atomic Collisions

PERIODICAL: Uspekhi fizicheskikh nauk, 1960, Vol. 71, No. 2, pp. 243-287

TEXT: In the present summary the author deals with the apparatus, methods, and results of experimental investigations of negative ion production, and above all with the determination of production cross sections for the case of collisions of ions and atoms with gas molecules. The production process of negative ions due to heavy-particle collision can be divided into two groups: 1) production of fast negative ions: $A^{k+} + B \rightarrow A^- + B^{(k+1)+}$; 2) formation of slow negative ions due to a) charge exchange of negative ions with gas molecules: $A^- + BC \rightarrow A + BC^- \begin{cases} \rightarrow B^- + C \\ \rightarrow B + C^- \end{cases}$ and b) due to dissociation of gas molecules in positive or negative ions as a consequence of the impact of the fast charged particle: $A^{k+} + BC \rightarrow A^{k+} + B^- + C^+$, $(-1 < k < Z_A)$. As the processes of the second

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group have been little investigated so far, the present article is mainly devoted to those of the first one. First, some characteristic features of the two processes $A^+ + B \rightarrow A^- + B^{++}$, (k=1) and $A + B \rightarrow A^- + B^+$, (k=0) (capture of two electrons by single-charged positive ions - of two-electron charge exchange - and capture of one electron by neutral atoms), both of which belong to the first group, are described. These two are the only ones of this group, which have already been investigated. A detailed report is given on the results of cross section measurements. Furthermore, the following problems are dealt with: investigation of the dependence of the shape of the curve $\sigma(v)$ on the nature of the colliding particle pairs; interpretation of the shape of the curve $\sigma(v)$ on the basis of the adiabatic criterion of Massey by taking into account the particles excited in the process; the shape of the curve $\sigma(v)$ in the range of low velocities $(a|\Delta E|/hv) \gg 1$; shape of the curve $\sigma(v)$ in the range $v > v_{max}$; dependence of the cross section in the maximum on various factors; comparison of the cross sections of various electron capture processes. First, the apparatus and the method of measurement are described, and the following problems are discussed in detail:

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admixture of ions of different types but of equal mass and charge to the primary ray; admixture of fragment ions to the primary ray; admixture of neutral atoms to a primary ray of positive ions; neutralization of positive and negative ions at the input diaphragm and in the chambers of the analyzer; formation of negative ions by collisions of molecules of the residual gas in the collision chamber, and multiple scattering of primary and secondary particles in the gas in the collision chamber. In the following the results of measurement are dealt with, and first some general problems are discussed and the investigated ion pairs (gas - ion) for the reactions $A^+ \rightarrow A^-$ and $A^0 \rightarrow A^-$ are compiled in a table. The following is described in detail: dependence of the shape of the curve $\sigma(v)$ on the selection of the colliding particle pairs for the processes $A^+ \rightarrow A^-$ (Figs. 2-6) and $A^0 \rightarrow A^-$ (Figs. 7-9); interpretation of the shape of the curve on the basis of Massey's adiabatic criterion by taking into account the excited particles in the processes $A^+ \rightarrow A^-$ (Figs. 10-11, Tables 2-4) and $A^0 \rightarrow A^-$ (Figs. 12, 13). $\sigma(v)$ in the range of low velocities, $A^+ \rightarrow A^-$ (Figs. 14, 15, Table 5), $A^0 \rightarrow A^-$ (Figs. 16-18, Table 6); $\sigma(v)$ in the range $v > v_{max}$ (Fig. 19); dependence of σ_{max} on

various parameters $A^+ - A^-$ (Figs. 20-24) $A^0 \rightarrow A^-$ (Figs. 25-28); comparison of the cross sections of the processes $A^+ \rightarrow A^0$, $A^0 \rightarrow A^-$ and $A^+ \rightarrow A^-$ (Fig. 29). In the last chapter of the paper, some data are given on the formation of slow negative ions in atomic collisions (Table 7, Fig. 30). The following Soviet personalities are mentioned: L. D. Landau, M. I. Korsunskiy, V. M. Dukel'skiy, and N. V. Fedorenko. There are 30 figures, 7 tables, and 63 references: 35 Soviet, 12 British, 8 American, 6 German, 1 Swiss, and 1 Hungarian.

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AUTHORS: Kozlov, V.F., Marchenko, V.L., and Fogel', Ya.M.

TITLE: A High-Frequency Ion Source with Discharge Taking Place in the Vapours of Salts

PERIODICAL: Pribory i tekhnika eksperimenta, 1961, No.1, pp.25-28

TEXT: High-frequency ion sources using hydrogen as the working gas are widely used in accelerator technology to obtain hydrogen ion beams. High-frequency ion sources have also been used to obtain nitrogen, carbon, oxygen, chlorine, boron and fluorine ion beams. To obtain these ions, use was made of gaseous compounds of the appropriate elements; for example, to obtain C^+, Cl^+, B^+ and F^+, the gases CO_2, CCl_2F_2 and BF_3 were employed. However, it is difficult to obtain ions of metals in this way because the relevant elements do not form gaseous compounds. This difficulty can be overcome by producing the ion beam from the plasma in a discharge occurring in the vapours of solid compounds. This type of ion source is described in the present paper. A sectional drawing of the device is shown in Fig.1. The discharge chamber is in the form of a cylindrical quartz container 30 mm in

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diameter and 200 mm long. At the lower part of the chamber there is a spherical bulb 1 containing the substance to be evaporated. The extracting potential difference is applied between the anode 2 and the probe 3. The anode is in the form of a tungsten wire 1 mm in diameter and is spot-welded to a molybdenum foil 0.05 mm thick, fused through quartz. The gas discharge is initiated by means of the coil 4 which is wound on the quartz chamber. The extraction system consists of the probe 3, which is made of the Electron alloy, and the quartz jacket 6. The channel in the probe is 11 mm long and 3 mm in diameter. The extraction system is held at the end of the copper tube 7 which is screwed into the flange of the source. The extraction system can be moved by rotating this tube relative to the flange. The gas is admitted through the leak valve 8 and the pumping speed is controlled by means of the valve 9. Electrical heaters 10 and 11 (900 W each) are attached at each end of the discharge chamber. The lower heater is used to evaporate the charge in 1, while the

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